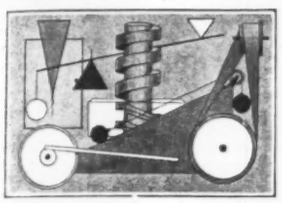
MACHINE DESIGN

as it affects

ENGINEERING–PRODUCTION–SALES

Volume 4 | May, 1932 | Number 5



Next MONTH

COMPLETE units are the order of the day! As with some of the newer houses equipped not only with stoves but with clothes washers, kitchen aids, etc., so with machinery.

This is particularly noticeable in connection with control apparatus. Machine builders know the type of control best suited to the conditions and consequently a large proportion of this equipment now is incorporated in original design. The trend will be discussed in an article to appear next month.

L. E. Jermy

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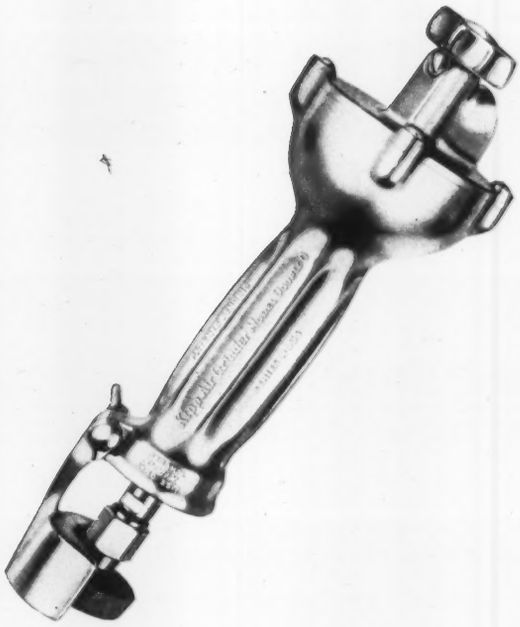

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30,000 revolutions per minute is the governed speed of the new Madison-Kipp Double D air driven grinder. This is a companion tool to smaller and even faster Madison-Kipp hand tools. All models utilize N-D-Seal ball bearings. Every conceivable test by Madison-Kipp engineers convinced them that New Departures were most satisfactory for this strenuous duty. They have the accuracy, stamina and speed ability. Mountings must be rigidly correct at high speeds, so it is always a good plan to go over your problems with New Departure engineers. This service is free and frequently gains new sales features for your product. The New Departure Manufacturing Co., Bristol, Connecticut.

1889

NEW DEPARTURE BALL BEARINGS

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Key: Edit, Editorial Pages; Adv, Advertising Pages; R, Right hand column; L, Left hand column

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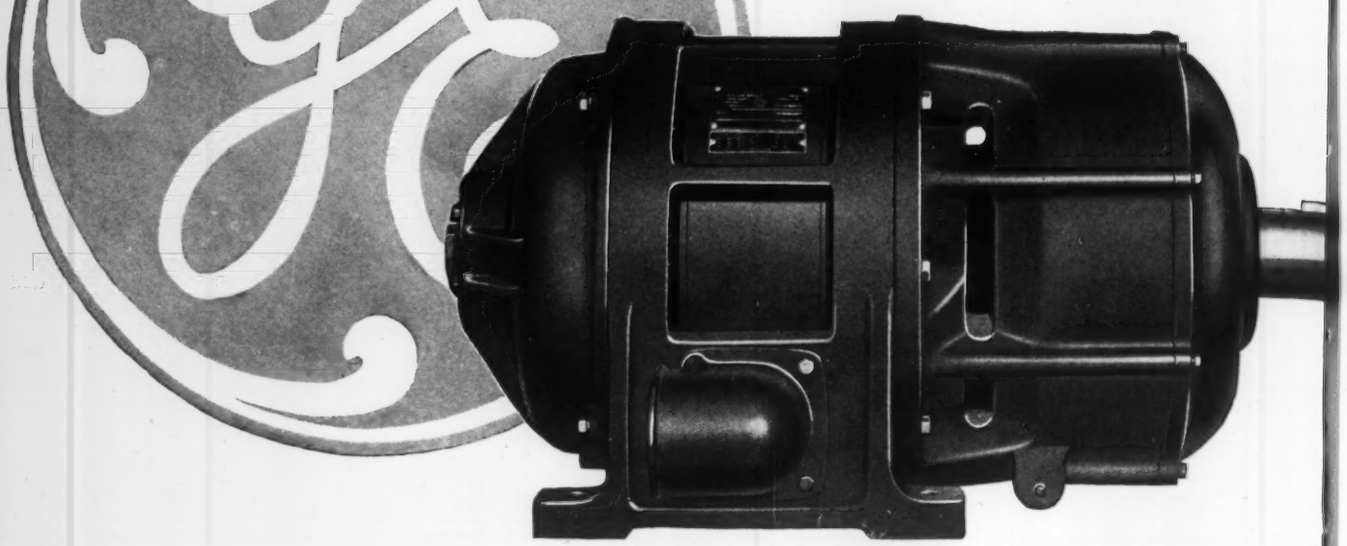
THE function of Machine Design is that of a conveyor of ideas on design from one type of machinery manufacturer to all others, all machines being fundamentally the same and incorporating similar basic principles, materials and parts.

Under present conditions it becomes all the more important that those responsible for design keep informed of design developments in all fields for possible application of these developments to the machines they are designing.

GEAR-



GENERAL ELECTRIC GEAR-MOTOR
Typical of skeleton-frame motors

GENERAL ELECTRIC GEAR-MOTORS meet the machine designer's requirements for an efficient, compact, economical, low-speed power unit. The complete line is based on designs of standard motors and planetary gearing which have been thoroughly tested and proved to be reliable. The GEAR-MOTORS deliver the rated horsepower of the motor at the low-speed shaft, because of the high efficiency of the helical gearing. The use of this helical gearing and Textolite planets bathed in oil results in quiet-running gears.

The built-in construction, with the planetary gearing an integral part of the unit, makes the GEAR-MOTOR very compact and simple to install. The GEAR-MOTOR, with its self-contained gearing, delivers the required low speed direct, and simplifies the machine designer's problem of limited space and economical construction. Complete information can be obtained from the nearest G-E sales office, or General Electric Company, Schenectady, N. Y.

G E N E R A L

MACHINE DESIGN

THE JOHNSON PUBLISHING COMPANY, CLEVELAND, OHIO

May, 1932 Vol. 4—No. 5

Does Optional Equipment Permit Standardization?

By H. F. Shepherd

WHY design different models when one, with changes, will serve? The same basic construction often can be retained, as pointed out in this article. The author is associated with International Derrick and Equipment Co., of Texas, a division of The International Stacy corporation.

DESIGN can be complicated and costly, or simple and economical. Particularly so when changes in the unit must be taken into consideration to make it adaptable to different sets of conditions either in location or in operation.

A pertinent example of such a case may be found in the marine engine field. An order may be booked for several large marine diesels with the controls and valve gears arranged as for port engines. It would save time and mental effort to design just what has been specified but every designer knows that some day someone probably will want a pair of engines of that same size, one of which will have to be built with the controls and valve gear as for a starboard engine in order that both engines may be served from a single station on the grating

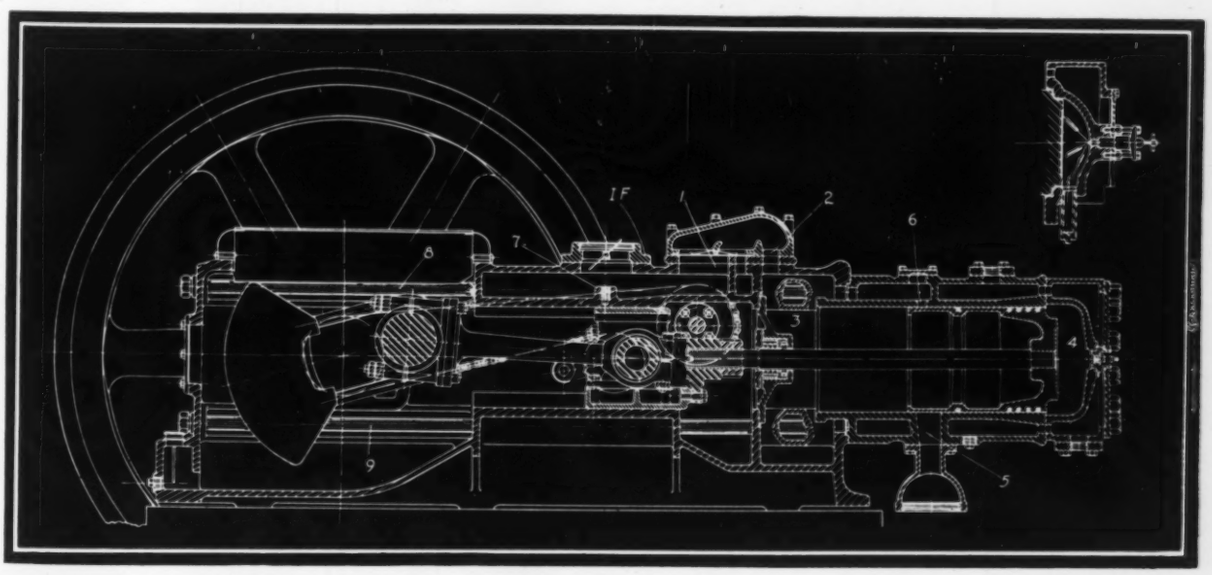


Fig. 1—Section of two stroke cycle engine convertible for use of natural gas or fuel oil

between them. So the engineering department falls to and arranges bed and frame patterns so that the two ends or the two sides are symmetrical as to pads for brackets and consols. A second set of drawings thereby is eliminated, also loose pattern pieces which always are disappearing or appearing in the wrong places.

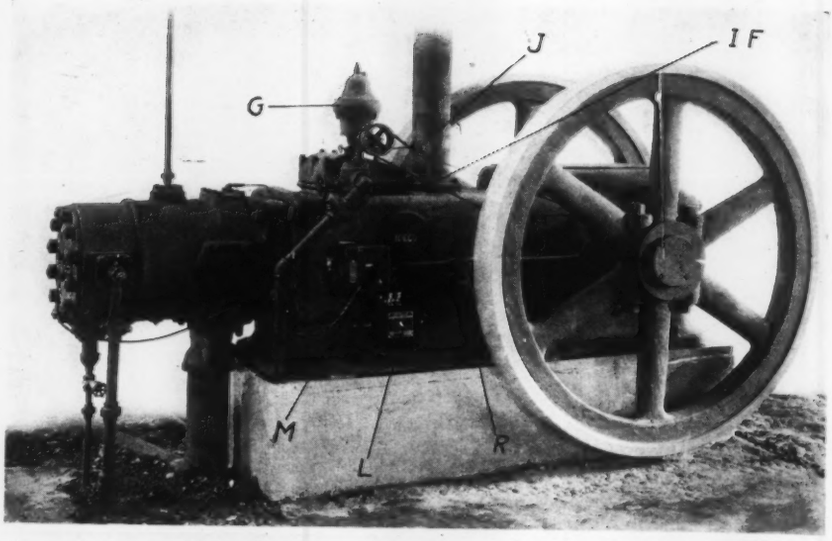
The foundry and pattern shop are spared the necessity of calling for a referee from the engineering department to settle what a port engine is, anyway, or whether a starboard engine fitted for generator drive becomes a right-hand unit or a left-hand unit.

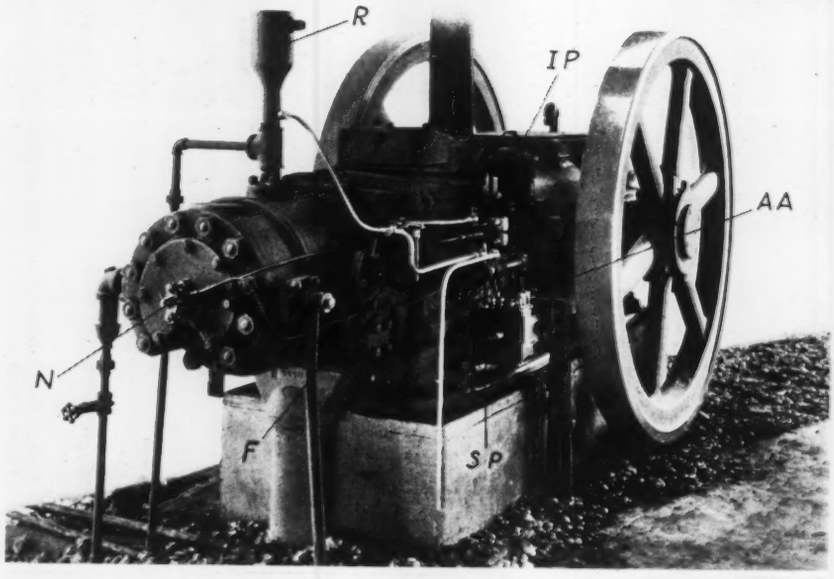
A new vertical engine may be designed to drive a certain generator. The next order possibly will require another make or kind of generator, or the shaft may be coupled to a marine reverse gear or a stub shaft carrying a thrust collar. Therefore, shaft ends are flanged close to the drive-end bearing to some standard if any exists. A great number of shaft drawings is saved, spares or replacements can be supplied from a reasonable inventory and stock engines may be built.

In the building of multi-cylinder engines it is possible to locate the valve cam keyseats so that a single cam design serves for both inlet and exhausts for clockwise or counterclockwise rotation of generators and for both the ahead and reverse cams on a reversible engine. The cam nose simply follows or leads its keyseat as required. This measure saves a vast amount of trouble in stores and is a service to the purchaser.

Yet many engine designs require two to four kinds of cams and there is a case on record of an eight-cylinder engine that required five different kinds of power cylinders because of different pads required to carry various units mounted on the jackets.

In the design of horizontal center-crank engines provision always is made for rights and





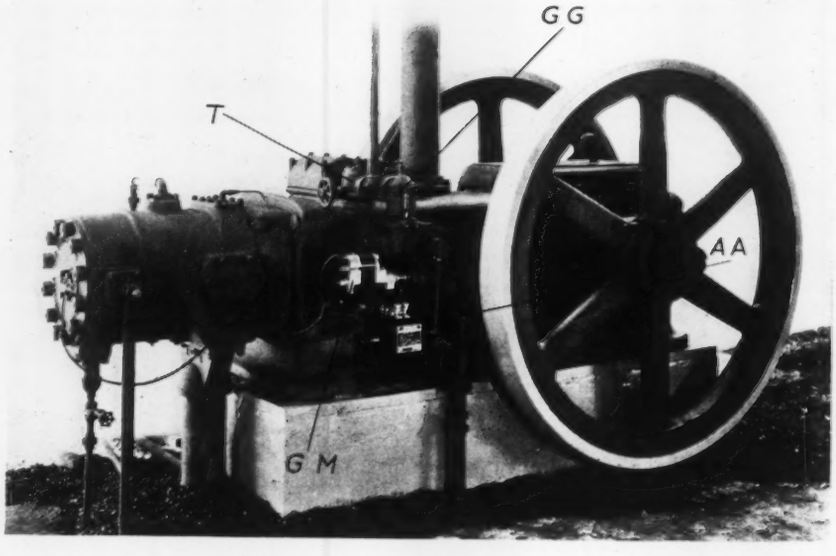


Fig. 2—(Top)—Engine arranged for gas as fuel. An oscillating magneto is used in this instance, driven from the crankshaft. Fig. 3—(Center)—Engine converted for burning fuel oil. Magneto drive seen in bottom illustration is employed for the rotary fuel supply pump. Fig. 4—(Bottom)—Modification of engine shown at top, a geared governor replacing belted type and a geared magneto being used instead of the oscillating model

lefts from a simple pattern. This may leave some vacant pads which may carry neat cast iron covers with the builder's escutcheon, often with improvement rather than detriment to appearance.

Beyond the main structure accessory drives must be considered. Ignition apparatus, governors, fuel filters, fuel injection equipment and force feed lubricators are specialties available in several forms. It is desirable to provide for neat and practical applications of the equipment required by the user. This necessitates pads and drives that must be disposed studiously if the general effect of each arrangement is to look well. Also it is desirable to avoid costly machine work to accommodate the equipment that may not be attached. The oil well pumping engine has required special study of this feature.

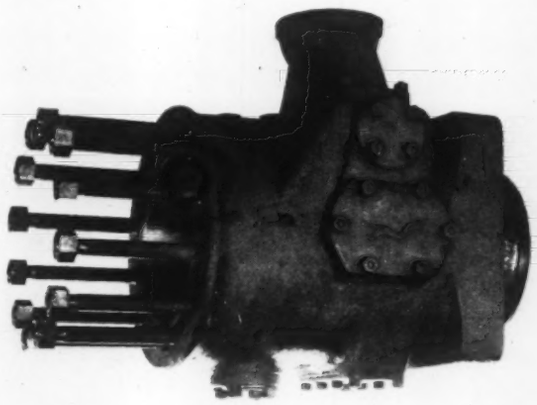


Fig. 5—Turning the cylinder upside down puts piston weight on the cooler, inlet side and permits straight exhaust pipe through roof

These internal combustion engines, using natural gas or crude oil for fuel, operate without attention other than a daily visit, the pumper often having 25 or more isolated engines in his care.

They are expected to have a life of 20 years or better, scoring over 99 per cent of the possible operating hours at a low upkeep cost. The pumping well is not such a bonanza as the flowing well and lost production is charged against the power plant. A producer may own a few engines or a few thousand engines, depending on the extent of his operations. The major oil companies place the purchasing, operation and servicing of these units under engineering supervision. Careful accounts and logs are kept.

It would seem that this procedure should result in a standardized engine but the problem is not merely one of mechanics. Some producers are obliged to strip a "rig" to its bare essentials since investment charges are a serious item of production cost when the output of the well is small. Others under more favorable economic conditions or with the viewpoint that a nice plant will be kept in good order purchase the more refined equipment available and give the whole installation a permanent character.

Fortunately, a general type of engine is approved almost universally for this work. It is described as a two stroke cycle single acting engine with crosshead and with power piston scavenging.

Valve Troubles Are Eliminated

The section shown in Fig. 1 aids in describing its operation. On the instroke, air is drawn through an automatic valve over passage 1 and gas is taken in through passage 2 except when oil fuel is used. The two, intermixed, are drawn after the piston into chamber 3. Compression of the charge in the cylinder into the combustion chamber 4 takes place at the same time. Ignition occurs near dead center. The piston is driven out and the new charge in chamber 3 is lightly compressed. Near the end of the outstroke the burned charge in the cylinder proper is exhausted to atmospheric pressure at the uncovering of the exhaust ports 5 by the piston. A little later the inlet ports 6 are uncovered, the fresh charge scavenges the cylinder, refilling it, and the cycle repeats.

The crank and motion work run in a bath of oil which is isolated from the cylinder by a bulkhead and the stuffing box with special metallic oil scraper rings on the piston rod. Thus contamination of the oil bath in the crankcase by burnt oil dripping from the cylinder is unknown and oil pumping or the loss of oil from crankcase to combustion chamber by the pumping action of piston and rings is avoided.

In its most common form, Fig. 2, the oil well pumping engine uses a commercial belted governor *G* equipped with a safety stop actuated by the jockey pulley *J* and its arm. Breakage of the belt causes the pulley to drop and a cam on the arm fulcrum closes the gas throttle. Coupled with this governing apparatus an oscillating or reciprocating magneto *M* is driven by an eccentric mounted on the crankshaft. The same eccentric drives, by any convenient form of attachment, force feed cylinder lubricator *L*.

Mechanism Is Simple and Exposed

In this case it is driven by the rocker *R* for a reason that will appear later. This is the cheapest and simplest accessory drive in general use and what is often most important its functions are obvious and unmistakable to the pumper who is not always adept at following out novel and hidden mechanisms. Engines are only part of his business, a fact which should be considered sympathetically.

It is held by some that the oscillating or reciprocating form of magneto is not suitable for

variable speed engines. The armature movement in one direction is forced by a cam or eccentric. This movement is comparatively slow. After tripping, the armature is returned by a spring. This free movement taking place at a high velocity energizes the coil and opens the breaker contacts, building up the high inductive potential required to jump the gap of the spark plug. The free or spring motivated function requires a certain interval of time regardless of the speed of the engine.

The fuel and consequently the speed at such times is under control of the man on the derrick floor but as he has a clutch and sometimes a brake to handle as well, beside directing his two "roughnecks," derrick control of the spark setting is avoided. Consequently, if 6 degrees of crank travel is required to actuate the spring-controlled magneto at 180 revolutions per minute, 12 degrees of travel will be used at 360 revolutions per minute, retarding the spark six degrees at a time when it would be most desirable to advance it. This being true, a geared rotary magneto operated by a layshaft often is specified. The timing is at least constant.

In Fig. 4 is shown the same engine as in Fig. 2 but equipped with a chain driven layshaft, geared governor *GG* and geared magneto *GM*. This magneto runs at twice engine speed to give a good spark at low revolutions and is equipped with both clockwise and counterclockwise impulse couplings for hand starting. The driving chain runs in the oil bath in the crankcase, and the governor is connected to the same throttle valve *T* as is used with the belted governor. The

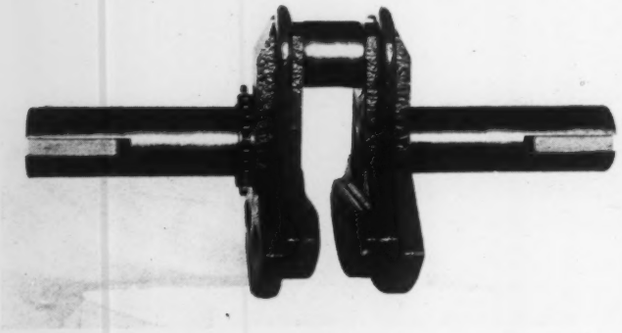


Fig. 6—Long U-bolts are used for fastening counterweights to avoid stress concentration of short straight bolts and to expose fastening for sounding and inspection

lubricator, in exactly the same position as before, is driven by a crank on the layshaft.

One reason for the employment of an oscillating magneto with the gas engine is its low first cost and simplicity. When used, however, it should be driven by a layshaft the bearings of which being lightly loaded remain snug. The more heavily loaded crankshaft with its contrary belt pull if not carefully maintained may play in its bearings and thus cause irregularities in the time of tripping the magneto. This demand is met by using the fuel injection pump drive for the oscillating magneto, with another cam of proper contour.

Fig. 3 shows the converted engine. The magneto drive operates a small rotary fuel supply pump *SP* bracketed to the magneto pad. This pump lifts fuel from an underground tank to a reservoir *R* the overflow from which is returned together with all other drips to the tank. The injection pump *IP* receives fuel through the filter *F* and at the proper intervals forces it through the spray nozzle *N* into the combustion chamber. This pump, too, is driven from the layshaft by a suitable cam.

Air Starting May Be Utilized

Any one of these arrangements must permit hand starting but since wells have been prorated and engines may be started and stopped every day instead of operating continuously, air starting is more common. The automatic air starter valve, cam driven from the layshaft in Figs. 3 and 4 may occupy exactly the same location in Fig. 2, being driven then by the rocker *R* which also drives the lubricator.

It is not a new idea to turn the cylinder "upside down" as in Fig. 5. While the arrangement shown in Fig. 2 is still prevalent there is a tendency toward the inverted arrangement. This puts the piston weight on the cooler, or inlet side of the cylinder and allows use of a simple straight exhaust pipe through the roof thus requiring no trenches and no expansion joints. The cylinder flange accordingly has been made symmetrical so that engines may be assembled either way at no additional cost.

The air inlet flange *IF* Figs. 1 and 2 is provided with a turned spigot which is threaded for 6-inch pipe inside and tapered for 8-inch sheet metal pipe outside. In case operators prefer to take air from the engine house, a tap 7, Fig. 1, is provided for a central stud in the bed below the flange to accommodate the usual bell cover over the intake.

The simplest engine, Fig. 2, is taxed with little additional machining cost for the accommodation of other equipment. Explicitly there is added only the layshaft seats, two 2½-inch holes 3 inches long bored transversely in the bed, and their faces which are milled simultaneously with other pads. Any of these conversions can be made in field or warehouse in short order.

The cylinder head for use with oil fuel, shown in detail separately in Fig. 1, is of a practical diesel form except for its small unjacketed surface. For many years bottle-necked combustion chambers were thought necessary for low pressure engines. The final application of the diesel idea of a simple chamber before the fuel nozzle, walled on one side by the piston only, met with instant success and has greatly simplified the foundry work.

SCANNING THE FIELD FOR IDEAS

A Monthly Digest of New Machinery, Materials, Parts and Processes, with Special Attention to Significant Design Features and Trends

Study Continuity in Production!

WITH continuous processes, engineers have provided more advanced manufacturing economy, but not without intense study and development of machines and mechanisms. This trend has brought out ingenious ideas, typical of which is the process wherein rayon thread from the time of precipitation goes through all remaining steps without interruption. W. H. Furness, president Furness Corp., Gloucester City, N. J., conceived the plan.

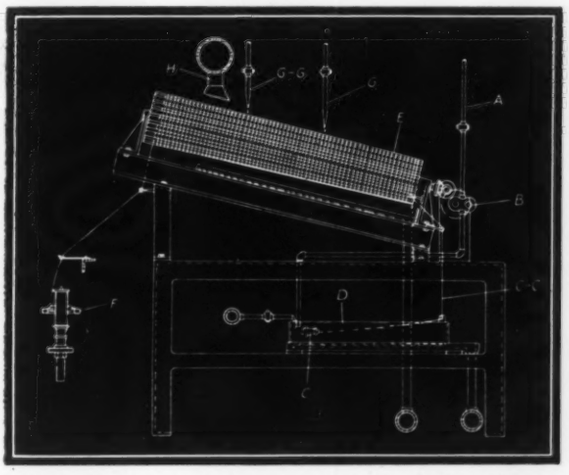


Fig. 1—Diagrammatic arrangement of apparatus employed in continuous cupro-ammonium process

The continuous arrangement, Fig. 1, has a pipe line *A* leading from a source of supply of copper ammonia cellulose solution which is forced by pump *B* through spinneret *C*, emerging as a sheaf of continuous filaments *CC*. These filaments make up the thread which passes through caustic soda bath *D*, in which the spinneret is immersed. From the bath the thread passes over guides to a squirrel-cage drum *E*, actuation of which carries the thread to its upper end. At the final stage of the process a twister mechanism *F* lays the thread on the spool with a twist.

As the thread is carried in the form of a helix along the drum it is exposed to various treatments it must undergo before reaching the spool. Pipes *G* and *GG* drip acid and water, respectively on the rayon thread and pipe *H* delivers warm air to dry it. To compensate for elongation of the thread the squirrel-cage drum is tapered slightly from its lower end to the point where the water is dropped on.

Construction of the drum to carry the thread along embodies an interesting mechanism, Fig. 2. A number of bars extend longitudinally around the periphery of the drum. Each alternate bar *I* is carried at each end by a disk, one of which is shown at *J*. Other bars *K* are carried at one end by a disk *L*, with the other end similarly supported. The bars are carried on the disks through the medium of pins *M*. It will be understood that the mechanism at each end of the cylinder is similar in construction.

Bearing *N* is so arranged that the section *O* of the drive shaft inclines from horizontal, which cants disk *J* from the vertical. Disk *L* at each end of the cage is mounted on ball bearings eccentrically and is canted in the direction opposite the disk *J*. Since the disk *L* rotates about the center *R*, eccentric to the axis of rotation of the shaft section *O*, and since the axis of rotation *R* is to the left (in the figure) the bars *I* and *K* extend in the same plane when passing around the bottom. As rotation continues, however, bars *K* recede in progression toward the

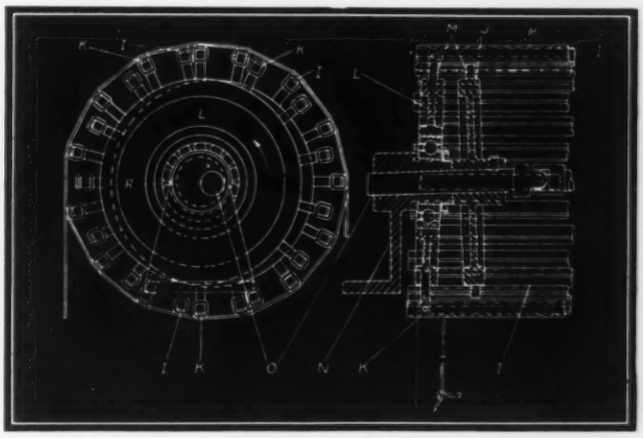


Fig. 2—Squirrel-cage cylinder embodies reciprocating bars mounted on eccentric and canted disks

center until they reach their lowest point, when they gradually move outwardly until, at the top, they are again in the same plane as bars *I*.

While the bars *I* are moving to the right they are out of engagement with the thread which at that point is carried forward by bars *K*, to the extent of the canting of disk *L*. When bars *I* are moving to the left the thread is engaged by them and is advanced due to the canting of disk *J*. After bars *I* have carried the thread to the furthermost point, bars *K* again pick it up and the thread continues to advance so that it is wound upon the drum in the form of a helix.

The time required for the complete operation is about 1½ minutes from the liquid cellulose solution to the finished, conditioned yarn twisted on the spool. It is said that former methods have required several hours for transfer of the dissolved cellulose into yarn due to the noncontinuous process involved.

Electrified Disk Saws Metal

EXEMPLARY of radical innovations recently introduced into the welding field which may bring about profound changes in conventional methods of cutting metal is an electric

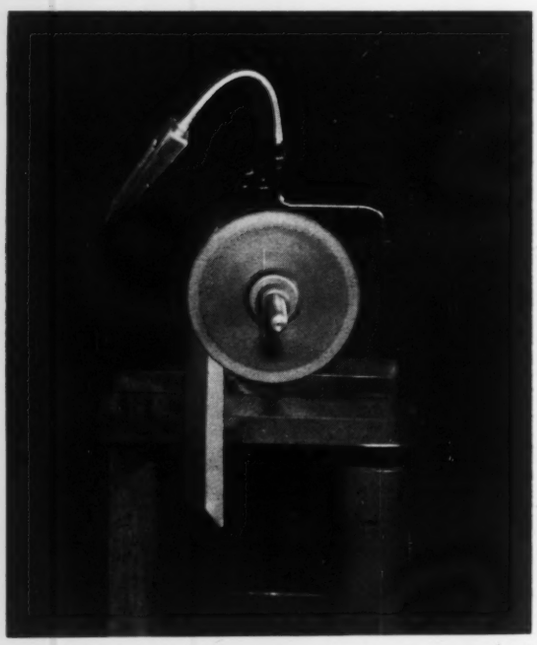


Fig. 3—Wheel is one electrode and work the other on this electric arc saw

arc cutting saw patented by Electric Arc Cutting & Welding Co., Newark, N. J. In the unit, Fig. 3, the cutting wheel constitutes one electrode and the work to be cut is the other. Several hundred amperes at low voltage pass between the cutting wheel and the work, the wheel revolving and continuously presenting a new and comparatively cool surface to the work.

An interesting feature is that the wheel, instead of wearing out, gradually increases in diameter. The reason for this is because particles of the metal being cut attach themselves little by little to the cutting wheel, which makes it necessary to shave the wheel to its original dimensions from time to time.

For certain types of alloys, carbon, carborundum and copper alloy wheels are used, while for cutting mild steel a steel wheel is employed. The wheels are driven rapidly, results improving in proportion to the speed. It is desirable to drive by belt so that in case of momentary sticking, the belt will slip and free the wheel.

Multiple Units Speed Operations

IT IS NOT uncommon that the development of a new machine part should necessitate the creation of a specially designed machine to produce it, particularly when the manufacturing process deviates from common practice. The engineer in an instance of this nature is thrown upon his own resources and it is in such cases that a wide knowledge of the machinery field will almost always provide him with an idea directly applicable to his problem.

Typical of a radical change in the design of a more or less common automotive part, necessitating a new manufacturing method, is the centrifuse brake drum. This unit, described in January MACHINE DESIGN, is, in brief, a steel rim first formed with two external flanges centrally located and an inturned flange at each side. The latter flanges form a trough which holds the poured cast iron when the rim, at white heat and "fluxed," is rotated at high speed.

When the idea of the alloyed iron-lined drum was conceived by Campbell, Wyant & Cannon Foundry Co., Muskegon, Mich., several methods were unsuccessfully tried to produce it, until centrifugal casting was attempted. Results then showed considerable promise but the ensuing problem was the design of a machine to turn out the lined drums rapidly and economically. The culmination of the engineers' endeavor is the unique arrangement shown in Fig. 4.

A turntable was developed to accomplish much the same thing as a similar idea employed in the Rotolactor, a machine which washes, dries and milks 50 cows every 12½ minutes (MACHINE DESIGN, January, 1931). The revolving table has been used in numerous other instances to meet definite production schedules. The turntable, 15 feet in diameter, used in this foundry machine is composed of 12 cast segments, bolted to each other. The center support block constitutes a bearing which fits over a pivot bolted firmly to a central concrete pier. For rotating the table a heavy chain is used on the face of the outer circle formed by the segments.

Centrifugal casting machines are mounted on the segments, one machine on each. Oil and water piping, pumps, water cooling system, etc.,

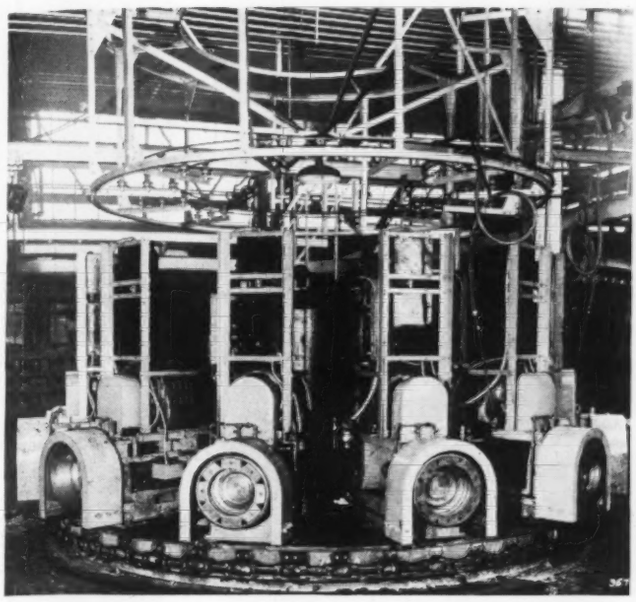


Fig. 4—Turntable carrying twelve centrifugal casting machines by which brake drum castings are produced

are mounted in the central portion of the turntable and the water and oil reservoirs are placed beneath that section between the arms, thus effecting a compact arrangement.

The water circulating system supplies water to cool the bearings on the centrifugal casting machines and the oil system serves two purposes, namely actuating the pistons which open and close the jaws of the chucks of the casting machines, and supplying oil under pressure to lubricate the bearings. The machines are so arranged on the turntable that when the bolts are removed a machine may be transferred as a unit by breaking only six unions which connect with the circulating system. This permits ease in changing machines if necessary without delaying production more than a few minutes.

Motive power to revolve each chuck is supplied by a 10 horsepower motor running at 900 revolutions per minute. The taper form of the chuck and of those portions of the jaws resting against the chuck provides a friction clutch which causes the jaws to revolve as a unit. While oil pressure on the piston ordinarily is sufficient to hold the jaws against the chuck housing with a margin of safety, an additional safety measure in the form of a mechanical locking device is provided.

Transfer Method Eliminates Packaging

TRANSPORTATION is a field that has clung to the "old way" of doing things, particularly where shipping of granular commodities is concerned. Sacks, boxes, barrels and drums have answered the packaging needs for the want of an idea to improve handling methods. Shovels and wheelbarrows also have played a part in these oftentime costly and cumbersome ways of transporting material from one place to another.

Former methods are changing as revealed by the development of a conveyor unloading device designed to be incorporated in a tank car. The idea originated with R. C. Pierce, vice president of engineering, General American Tank Car Corp., Chicago. Facility with which bulk liquids are handled by tank cars gave rise to the idea that this particular shipping problem might be solved by working along similar lines.

The arrangement shown in Fig. 5 has worked satisfactorily with such difficult commodities as cement and dolomite. The first models of this type of car employed two screw conveyors, each feeding toward a hopper in the center but the materials became packed so hard during movement over railroads as to prevent operation of the conveyors.

In outward appearance the new carrier resembles the conventional tank car except that it has six openings for loading instead of one. It has three compartments, two for carrying the lading and one housing the machinery. Two power-driven endless drag chains pulled along

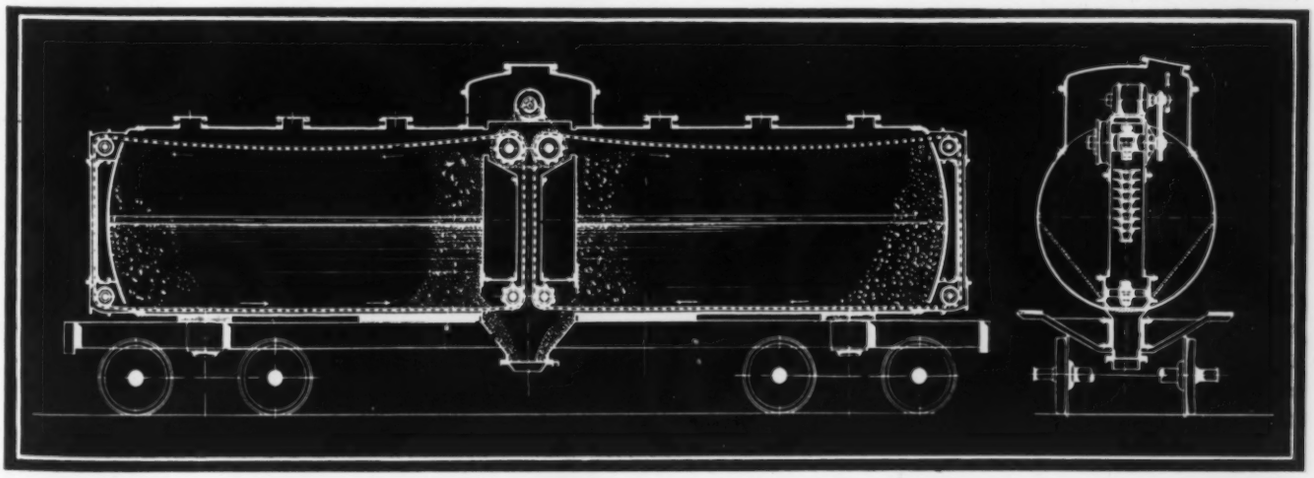


Fig. 5—Because screw conveyors failed, chain conveyors were utilized in this tank car which is used to transport granular commodities. Motor and speed reducer are in dome

toward the center outlet by means of sprockets unload the cargo. The conveyors are driven by a motor and speed reducer located in the dome or by external power applied to a shaft extending through the structure.

The conveyor chain in its course along the top of the car travels about three feet below the loading manways and does not obstruct them. Because there is a tendency for the teeth on the sprockets to force out material between the chain links, clogging does not occur. All bearings and the mechanism are protected from the lading, enabling the car to handle highly abrasive materials.

Felt Now Is Bonded to Metal

BONDING of materials, metallic to nonmetallic or metal to metal, has given to engineers engaged in design an interesting group of substances with diversified properties. Rubber and wood, for instance, have been bonded to metal successfully. Corrosion-resisting alloys are being welded to cheaper metals and then rolled, and gray iron now is bonded by centrifugal casting to steel shells for brake drums.

Recently the announcement was made at Mellon Institute of Industrial Research that there had been developed a laminated metal-felt material in which the felted materials are cemented to steel by heat and pressure. The composite laminated material, the outer surfaces of which are suitable felts, then is saturated with any desired solution chosen with reference to the corrosive condition to which the metal is to be exposed in service.

Paint, lacquer, and resin films superimposed

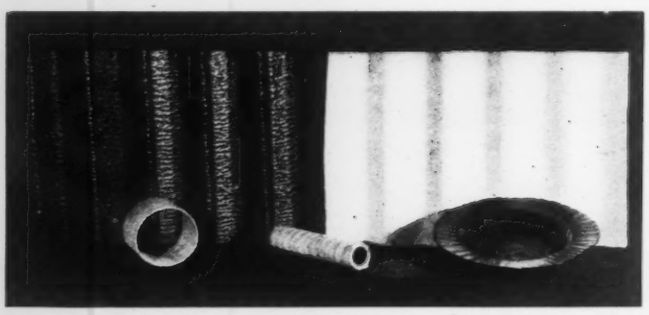


Fig. 6—Specimens of felt bonded metal shown include corrugated sheet, galvanized pipe and pressed terne plate

on the saturated felt give not only added protection but also desired attractiveness in appearance of the finished material. Because it is possible to choose between a number of felts and felt saturants to stand against various corrosive conditions, this new protected metal promises flexibility in providing corrosion resistance. The ductile nature of the metal bond between felt and steel makes it possible to subject this material to forming operations such as shearing, bending, corrugating, rolling and mild drawing without destroying adhesion properties.

Setting Latent Energy to Work

HARNESSING existing power or in other words utilizing latent energy should be one of the aims of all designers of machinery. A successful example accomplishing this is the Stewart-Warner power unit which utilizes the

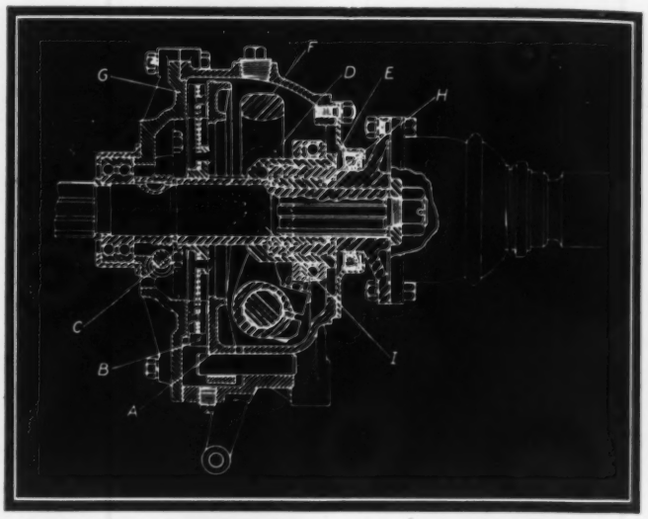


Fig. 7—Arrangement of parts in power unit which utilizes momentum of automobiles for braking system

momentum of the automobile to effect operation of the braking system. The idea is unique and has possibilities in the industrial field.

The conventional brake pedal actuates a pressure plate *A*, Fig. 7, which is forced against friction disk *B*, rotating on an extension of the transmission main shaft. This disk is carried on a splined sleeve *C*, which, through its spline, slidably engages an outer actuator *D*. On the inside of this actuator is a steeply pitched left-hand thread meshed with a thread on the periphery of an intermediate actuator *E*.

When the car moves forward depression of the brake pedal causes the sliding pressure plate to move forward by reason of the input yoke *F* which is attached to the foot pedal through linkage. This action causes the pressure plate *A* to be forced against the friction disk *B*, which in turn is urged with equal pressure against a wear surface on the stationary adaptor plate *G*.

Gradual retardation of the friction disk will rotate the splined sleeve *C*, relative to the shaft, so that the intermediate actuator *E* and the external actuator *D* will wind forward as a unit on the longitudinally fixed right-hand thread actuator *H* and apply the output yoke *I*.

In reverse the left-hand thread on the outside of the intermediate actuator *E* winds the outer actuator *D* forward to apply the output yoke in the same way.

How Much Should Engineers Engage in Society Activities?

By L. E. Jermy

Editor, Machine Design

IN INTRODUCING the subject of the relation of the design engineer to his professional society, it will be advisable to define the scope of our investigation. We believe it is safe to assume that every competent person will agree with the premise that engineering societies have a useful mission and that in general engineers who are sincerely ambitious to rise in their profession should belong to at least one technical organization.

Granting that this assumption is sound, the problem resolves itself into a question of the extent to which an engineer should participate in the activities of technical societies. Therefore in this and next month's installment of this series of articles, we will restrict discussion to factors which bear upon this question.

What do design engineers owe to their profession? What are their obligations to engineering societies? How far should they enter into their activities? What benefits can they reasonably expect from such participation?

It would be foolish to say that the ability of an engineer can be measured by the extent or enthusiasm of his activity in society affairs. There are many able professional men who for one reason or another have little to do with technical associations. On the other hand, there are other hundreds who place far too much emphasis on association work. Some critics will question this last statement, but later on we will prove it.

What of these engineers who pay no attention to engineering societies? The majority are lacking in ambition or are so low in the scale that they have not acquired a pride in their profession. A few are really competent and their failure to mix with their fellows in engineering society affairs usually is traceable to some individual trait, such as bitterness, shyness, or perhaps lack of sociability.

We know of an engineer who ranks high in his chosen specialty. In his university he was popular and brilliant. Following graduation he had a hard time finding his place in the industrial world. After a few years of discouragement, he finally found work for which he seemed well fitted. His progress was rapid and before long he was recognized as a leader in his field.

But when success had come to him, he turned against his university and many of his friends. He declared he owed nothing to his college. He paraded as a self-made man. He refused to share his experience with others in various engineering societies. He harbors a bitterness against many institutions—a bitterness which has deprived him of many enjoyable and profitable professional contacts and which already threatens to interfere seriously with the value of his work for the corporation that employs

PARTICIPATION in the affairs of technical societies presents a problem to every ambitious design engineer. Somewhere between the extremes of no interest and excessive interest in association work is a medium course to which engineers can adhere with complete assurance.

What is that medium course? The accompanying article and letter and the companion article and letter to be presented in next month's issue are intended to help you answer this all-important question. We are drawing upon the experience of association secretaries and design engineers to help you. The consensus of opinion should point the way to a sensible attitude toward society activities.

—The Editors

him. This is an unusual case. We mention it for the purpose of illustrating the one extreme—the man who refuses to have anything to do with technical societies.

At the other end of the scale are the engineers who spend too much time and thought on society affairs.

We have in mind a certain engineer who ranked only slightly above the average in attainments in his field. Early in his career he became active in the local chapters of several technical societies. Later he was taken into the councils of the executive board of a national association. In due time he was elected president.

This imposed many time-consuming duties. He visited local chapters and student groups, addressed meetings several times a week, and naturally was able to give only fleeting attention to his own work. At the end of his term of office he tried to pick up the loose threads of neglected job, but it was difficult. Now he was a celebrity. He was in constant demand as a speaker, as a member of committees, and as the publicized figurehead of campaigns, movements, etc.

Meanwhile it had become evident that his strenuous organization work had unfitted him for his regular duties. Constant association with famous national and international figures had made the exacting routine of design seem drab and uninteresting in contrast.

The foregoing is extreme only in that the man in question rose to great heights in spite of the fact he was not an outstanding engineer. He became unduly intoxicated with the glamor of

How the Technical Society Regards th

AS OFFICIALS of technical organizations we are always interested in the problem of the relation of the engineer to his society. It would be manifestly unfair, however, to discuss this subject in the light of conditions now existing in industry. Therefore, in reading the views set forth in this composite letter, please keep in mind the fact that we are voicing opinions on relations as we think they should obtain in normal times—not in periods of emergency as at present.

There is considerable difference of opinion as to why thousands of engineers never join technical societies. It has been claimed that the average association fails to "sell itself" to the profession it serves. Another group of critics has repeatedly charged certain organizations with excessive "commercialism"—meaning that they have been over zealous in seeking volume in membership at the expense of quality.

The leading professional associations pursue a policy which bars ballyhoo and high-pressure salesmanship and yet permits officers and staffs to present adequately the benefits to be derived from membership. If this policy fails—as it does in so many thousands of cases—in our opinion the fault lies as much with the engineer who refuses to become a member as with the society itself.

Estimates of the ratio of members in a number of representative organizations to the total number of eligibles for each range from 30 to 60 per cent. The explanations for this comparatively low percentage are many and varied. Inertia, short-sightedness, a too self-satisfied attitude, willingness to derive society benefits (published papers, bulletins, etc., from members) without holding membership oneself, financial reasons, and plain lack of interest in one's profession are a few of the factors.

There is a group of many thousands who hold down their daily jobs without contributing as fully as possible to the progress of their firms and their industry. If these men belong to local engineering societies they do so largely for social contacts. They read few engineering publications and those without studying the application of their contents to their own work. They interest themselves only in a limited field of activity and so miss many opportunities for making themselves more useful and more valuable to their employers, their profession and themselves.

Many of them miss the point that as a rule a technical society is created and maintained by their own profession and that it must be valuable to that profession or it would not long be supported. Apparently they forget that in pursuing their daily work they frequently spend valuable time and money in arriving at conclusions which others have long possessed and passed on to a technical society in a paper, report or discussion. They seem to overlook entirely that the dues of the average society are so low that a single idea gained through membership often will far exceed in value the sum paid for membership for several years.

The second major problem of association management—that of encouraging members to take active part in society affairs—is even more important than that of securing new members. We estimate that only from 5 to 20 per cent of the members of the average technical organization are active in holding office, serving on committees or contributing papers. Of the remaining 80 to

"To display several certificates on their office walls"

association work. It glorified him and raised him to an exalted position far above that he deserved. In the process it spoiled him.

In our opinion the proper course for average engineers lies about half-way between the two extremes just cited.

In general the tendency to neglect the opportunities of participation in technical societies is far more prevalent than the tendency to overemphasize them. To every engineer who goes to excessive lengths in association work there are perhaps thousands who do not go far enough. One of the great problems of managing a technical association is stimulating interest evenly throughout the membership so that the major burden and opportunity of activity do not fall on the shoulders of a few.

This very fact is convincing testimony of the unfortunate apathy of the great majority of engineers. Too many of them fail to understand that in order to derive benefits from association membership one must contribute more than the annual dues and occasional attendance at meetings.

No standard rule for the degree of participation can be formulated. Each engineer must work out his own solution. The proportion of time and attention he should give to associations depends somewhat upon his own ability, upon the character of his work, the attitude of his employers, the state of his finances and the opportunity afforded him to engage constructively in the activities of the technical societies to which he may belong.

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the Engineer—By a Group of Society Officials

"Were granted leave of absence to attend meeting"

95 per cent, probably far less than half attend meetings. Thus about 50 per cent of the entire enrollment confine their interest to the sole act of sending in their annual checks for dues. Only about 5 per cent of members are sufficiently interested to send in nomination or election ballots.

Reasons for this apparent apathy include lack of time, restraining influence of employers, lack of suitable data to contribute in papers, absence of initiative, and selfishness.

This last warrants explanation. Unfortunately there are a few members in every society who perhaps unconsciously expect to get more out of memberships than they put in. We know of numerous engineers—some of them of fairly high position—who originally enrolled in several societies purely from a desire to present an impressive list of memberships in "Who's Who in Engineering" or to display several certificates on their office walls. Without commenting upon the motive, we are obliged to say that few engineers in this category ever contribute papers or hold office.

Here and there one will find employers whose shortsighted attitude in discouraging their engineers from engaging in outside activities virtually constitutes a ban against participation in technical society affairs. In spite of this, engineers in the service of such employers have been known to go to conventions on vacation time and at their own expense. We believe that the attitude of management is an important factor in the problem of an engineer's relation to his technical society. The majority of companies are liberal in this respect, but there is room for considerable improvement among many firms.

In this connection members of associations sometimes fail to "sell" the value of participation to their superior officers. Not long ago three engineers from one company were granted leave of absence and given expense money to attend a national meeting. They entered into the discussions at several sessions, made notes of certain data and profited generously from attendance. When they returned they failed to make a report, and as a result the management of this particular company is unaware of the benefits these men derived from the meeting. We feel that engineers who are accorded liberal treatment in this respect by employers should reciprocate by helping to "sell" the value of association work to the management of their company. This can be done easily by showing officers how the individuals or the company are profiting from their participation.

Technical societies are obliged to depend upon a discouragingly low percentage of members and an even more pitiful percentage of eligibles for carrying the burden of work which is so important to the professions these societies serve. This nucleus consists of alert engineers who know by experience that mutual exchange of data with their fellows will bring them the accumulated knowledge and experience of their profession as a whole. They also are motivated somewhat by the spirit of service and pride in profession, which are priceless assets.

When the ratio of active members to the total number of members in each association rises—as it will inevitably—it will be a sure sign that the profession of engineering is advancing to higher ground. It will be encouraging proof that engineers are alive to the opportunities which, as so often reiterated by others in this series of articles and letters, are open to those who have ambition and vision.

MANY engineers have a somewhat vague understanding of combined stresses and how to take care of them in design. Such stresses include those set up in a spindle which has three or more supports. Mr. Hall, professor of mechanical engineering, Brown university, and consultant with Brown & Sharpe Mfg. Co., has simplified the determination of these stresses to definite formulas.

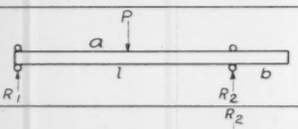
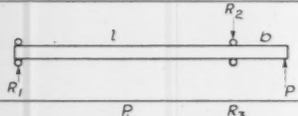
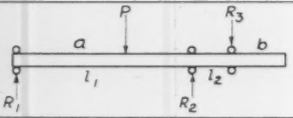
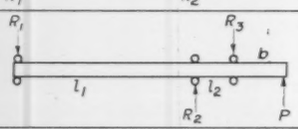
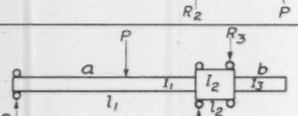
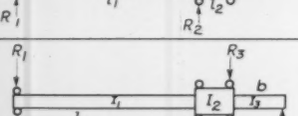
Calculating Spindle Loads and Deflections

By James A. Hall

ONE of the common reasons for using double row ball or roller bearings in spindle mountings is to give added rigidity to the spindle. In such cases the outer races are held rigidly in the frame of the machine instead of being placed in self-aligning seats. The beneficial results of added stiffness gained by this practice may be accompanied, however, by a large increase in bearing loads, so a discussion of the methods of calculating pressures and deflections under these conditions may be of considerable interest.

If a shaft has two pivoted supports such as given by self-aligning bearings or by a single row of balls at each support, the pressures can be calculated by the principle of simple statics. The slope of the spindle through either bearing and the deflection at any desired point also can be determined by using the principles of elasticity. If the spindle has three or more supports it is no longer statically determinate and the methods of elasticity must be brought

Fig. 1—Expressions derived for bearing reactions and slope in spindles with single and double row bearings

Case	Loading	Reaction at extreme right hand bearing	Slope at extreme right hand bearing	Deflection of point at "b" inches from extreme right hand bearing
1		$\frac{Pa}{l}$	$\frac{Pa(l^2-a^2)}{6EIl}$	$\frac{Pab(l^2-a^2)}{6EIl}$
2		$-\left[\frac{P(l+b)}{l}\right]$	$\frac{Plb}{3EI}$	$\frac{Pb^2l}{3EI}+\frac{Pb^3}{3EI}$
3		$-\left[\frac{Pa(l_1^2-a^2)}{2l_1l_2(l_1+l_2)}\right]$	$-\left[\frac{Pal_2(l_1^2-a^2)}{12EIl_1(l_1+l_2)}\right]$	$-\left[\frac{Pabl_2(l_1^2-a^2)}{12EIl_1(l_1+l_2)}\right]$
4		$-\left[P+P\frac{b(2l_1+3l_2)}{2l_2(l_1+l_2)}\right]$	$\frac{Pbl_2}{12EI}\left(\frac{4l_1+3l_2}{(l_1+l_2)}\right)$	$\frac{Pb^2l_2(4l_1+3l_2)}{12EI(l_1+l_2)}+\frac{Pb^3}{3EI}$
5		$-\left[\frac{PaI_2(l_1^2-a^2)}{2l_1l_2(I_1l_2+I_2l_1)}\right]$	$-\left[\frac{Pal_2(l_1^2-a^2)}{12El_1(I_1l_2+I_2l_1)}\right]$	$-\left[\frac{Pabl_2(l_1^2-a^2)}{12El_1(I_1l_2+I_2l_1)}\right]$
6		$-\left[P\left(\frac{2I_2l_1(l_2+b)+I_1l_2(2l_2+3b)}{2l_2(l_1I_2+l_2I_1)}\right)\right]$	$\frac{Pbl_2(4l_1I_2+3l_2I_1)}{12EI_2(l_1I_2+l_2I_1)}$	$\frac{Pb^2l_2(4l_1I_2+3l_2I_1)}{12EI_2(l_1I_2+l_2I_1)}+\frac{Pb^3}{3EI_3}$

into the determination of the bearing loads as well as the deflections.

A detailed discussion of the procedure to be used in deriving expressions for bearing reactions and slope in the latter cases would require a long and complicated article. The results of such a study are combined, therefore, in the chart, Fig. 1. The type of support is shown by diagram in the left hand column while the force acting on the right hand bearing is given next. The third column gives the slope of the spindle through the right hand bearing, and this is followed by an expression for the deflection at a point some distance in front of this bearing.

In all cases the force P is taken as positive in the direction shown in the diagram. If it acts in the opposite direction from that shown, it should be entered in the formula as a negative quantity. The expression for the bearing reaction is positive if it acts upward and negative if it acts downward. The value of the slope of the shaft at the right hand bearing is positive if it is upward to the right and its amount is in inches per inch of length. The expression for the deflection at a point in front of the right hand bearing is positive if upward from its unloaded position and negative if down. In all cases the dimensions are as indicated and the rectangular moment of inertia of the cross sectional area is given by the letter I.

Load Applied Between Bearings

Case 1 gives a simple shaft with two supports and the load applied between the bearings. The next case is similar except the load is placed at a point beyond the right hand bearing. If loads are placed at both positions the values of reaction, slope and deflection can be found by adding the results for cases 1 and 2, due attention being paid to whether the signs are positive or negative.

Formulas for a common spindle mounting where two bearings are installed at the front to secure rigidity while a single bearing is placed at the rear are included in case 3. The load is located near the center while in the next case it acts on the overhung section. Here also a combination of loads can be taken care of by adding the values.

Frequently such spindles are not of uniform section and this makes for a much more complicated solution. The case where the length between the bearings R_1 and R_2 is considered uniform, and that between R_2 and R_3 is also uniform but of a different value, is not particularly involved so this has been worked out for both types of loading under cases 5 and 6. The value of the moment of inertia of the cross section is taken as I_1 between R_1 and R_2, I_2 between R_2 and R_3 and I_3 beyond R_3.

As an illustration, a solid shaft two inches in outside diameter has been chosen, and the distance between bearings R_1 and R_2 taken as fourteen inches. Where there are three bearings the distance between R_2 and R_3 is made two inches. The load P is placed eight inches from R_1 when between the supports and overhung six inches when outside. In each case the load is taken as one thousand pounds. The results are shown in the chart, Fig. 2.

In the first two cases and the combination of these two, the loads on the bearings are relatively small, but the slope through the front bearing and the deflection six inches beyond are quite large. Where two bearings are used in the front support the slope at the front bearing and the deflection six inches beyond are reduced greatly, but the pressures on each of these bearings is quite large. The reason is that they act against each other in furnishing the added stiffness. The use of an enlarged section 3-inch diameter, on the shaft between bearings R_2 and R_3 has comparatively little effect on the bearing loads, but helps greatly in reducing the deflections at the front bearing and beyond.

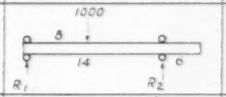
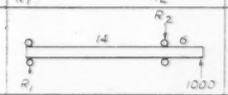
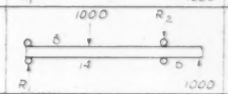
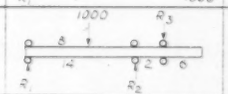
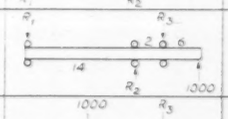
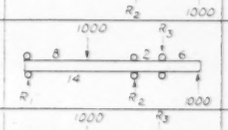
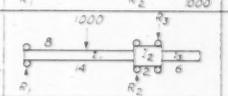
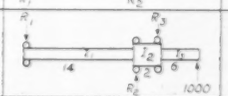
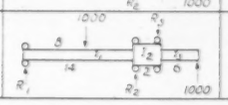
Case	Loading	Reactions in pounds			Slope (in per in) at extreme right hand bearing	Deflection (inches) at point 6" from extreme right hand bearing
		R_1	R_2	R_3		
1		429	571	0	.00053	.00320
2		429	-1429	0	.00119	.01020
1 and 2		858	-858	0	.00172	.01340
3		261	1918	-1179	-.000033	-.000198
4		-28	3216	-4188	.000165	.00404
3 and 4		233	5134	-5367	.000132	.00384
5		242	2068	-1310	-.0000073	-.000043
6		-6	3047	-4041	.000033	.00326
5 and 6		236	5115	-5351	.000026	.00322

Fig. 2—Results obtained from applying the expressions given in Fig. 2 to a specific example

A close examination of the formulas for bearing reaction show the importance of the distance between R_2 and R_3. If this distance is doubled

the load on the front bearing will be reduced to less than one-half its former value in case 3. The percentage reduction will be material, although not quite fifty per cent, in case 4.

Elastic deformation in the bearings themselves may cause a slight deflection under the loads and thus tend to reduce the forces acting at these points as well as increase the deflections of the shaft. To do away completely with the reactions of the double bearings against each other, the stiffening effect of the double bearings would be eliminated, and the deflections would be in the order of those caused by the slopes in the single bearing illustrations. For instance, if the combination of the first two cases is taken, the slope at R_2 is 0.00172 and a bearing two inches beyond would have to be at least 0.00344-inch out of line to carry no extra load due to stiffening effect. Even if this deformation is divided between bearings R_2 and R_3 the amount is many times larger than would be expected with preloaded bearings. The loads under any assumed deflection can be calculated without great trouble but the development of the equations is beyond the scope of this article. In general, it is not safe to assume any large percentage reduction in loads due to such deformations.

This analysis indicates that careful consideration of theoretical design is necessary where double row ball or roller bearings are used in spindles subject to heavy pressures. If a high degree of rigidity is required at the front of the spindle, the use of this type of mounting is highly desirable but care must be taken to place two rows a sufficient distance apart and to choose bearings of proper capacity.

Protective Shielding for Blades Features Turbine Design

By C. Richard Soderberg

PROGRESS in steam turbine development during the last ten years has been remarkable in several respects. Heat consumption has been decreased by the use of higher operating temperatures and pressures, and by methods of regenerative heating; turbine efficiency has been increased by refinements in the design of the steam path; and maximum size of individual units has been increased materially. These advances have been paralleled by improvements in reliability and by an equally remarkable reduction in weight and space requirements.

Some of the problems coincident with these developments were discussed in detail by Mr. Soderberg, manager, turbine apparatus division of the Westinghouse South Philadelphia plant, at a meeting held recently by the Engineering Society of Western Pennsylvania, at Pittsburgh. The accompanying article is an abstract of this paper.

In the steam turbine the problem of strength is presented in a more complete form than in most other rotating apparatus. The applications of stress involve all variations of importance, while materials encountered cover practically the entire range of those known to mechanical engineering. The designer of steam turbines, more than most other engineers, is confronted constantly with new and perplexing strength problems.

The most important and effective solution of the erosion problem, introduced by increasing the top speed, is to make the blading impervious to the bombardment of the water drops. It has been agreed for some time that, beyond the use of stainless steel, it is impractical to employ a blade material of sufficient inherent hardness to be impervious to the erosion. This leaves as the only alternative a protective shielding of some kind.

Chromium plating in thickness up to 0.005-inch has been used with a certain measure of success. It is an expensive method, however, and the question of renewing the coating is troublesome.

Fig. 1—Turbine blade shielded with hard-facing material to afford protection against erosion

Nitriding the blades on the inlet edges also has been used with satisfactory results as far as erosion protection is concerned. Nitriding the thin edges leaves them extremely brittle, however, and the method has not come into general use. Nitriding the thick inlet edges only is practical and when applied in this manner the method has attractive possibilities.

Separate shielding strips applied to the blades by welding or soldering were used by the Parsons company in England several years ago. The method has been investigated thoroughly in America and now is regarded as the most favorable solution. A tremendous variety of protective shielding has been tried, of which may be mentioned tungsten, tantalum, stellite, contracide, resistal and numerous others. Tantalum and stellite are the most promising, particularly the latter, having given excellent results in service on some large units. With this method of erosion protection, blades with tip speeds exceeding 1200 feet per second will give the same service as ordinary stainless steel blades for tip speeds of the order of 900 feet per second. Fig. 1 shows a blade shielded in this manner.

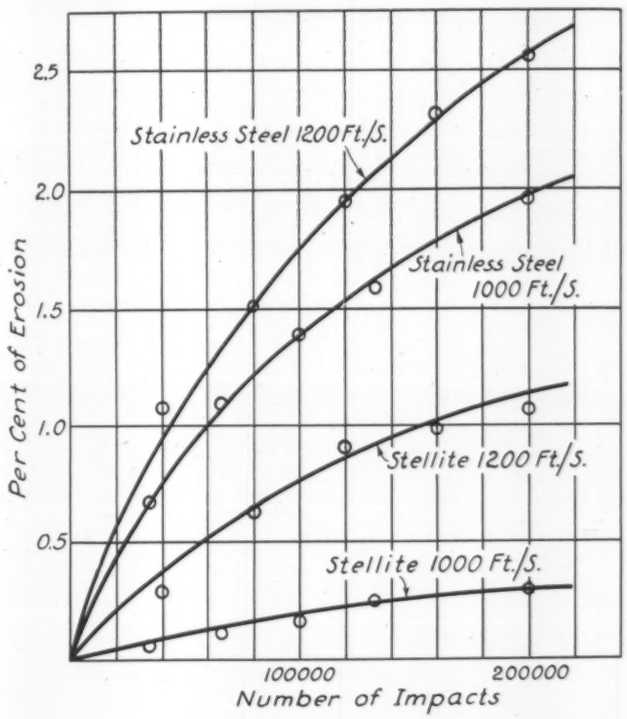


Fig. 2—Comparative results obtained with stainless steel and stellite-shielded blades

The problem of erosion protection received its greatest impetus by the development of a rational erosion tester. Fig. 2 gives comparative results obtained with such a tester for stainless steel and stellite for impinging speeds of 1000 and 1200 feet per second. The evidence in favor of stellite shielding is pronounced.

It is safe to state that no one problem has affected the development of steam turbines more profoundly than the metallurgical problem. The program has not always been rational, the materials have not been judged by rational standards at all times and many expensive developments have led to blind alleys, but progress, nevertheless, has been outstanding.

The most vital part of this development has concerned the high strength materials for the rotating parts. The use of carbon steel is still important, particularly for the generators.

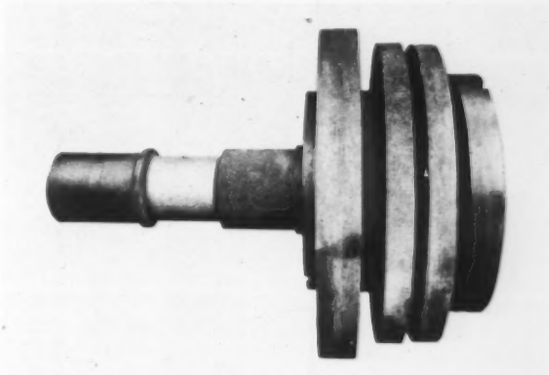


Fig. 3—Steel forging for a rotor with transverse joint at low pressure end

Nickel-molybdenum steel (2.5 per cent Ni, 0.25 per cent Mo, 0.40 per cent C) has gained an important place for this purpose. It now is possible to obtain forgings in weights of 75,000 pounds with a yield point of 60,000 pounds per square inch and a reduction area of 40 per cent in the tangential direction near the rotor ends. The development has required rotor forgings of still greater weight, however, so that certain rotor constructions have been made with a transverse joint at the high pressure end. On more recent constructions this joint has been moved to the low pressure end instead. Fig. 3 is an example of a steel forging of this type.

Should Eliminate Joints

While these constructions have given a good account of themselves, it is, nevertheless, desirable to eliminate such joints. The solution of this problem appears to be to mount the heavy blade rows on disks shrunk on the shaft. The central part of the rotor then can be made of a relatively inexpensive carbon steel, except for high temperature applications where an alloy steel must be used.

The important subject of blading materials has not been changed by any fundamental development during the last few years. Stainless steel (12 per cent Cr, 0.5 per cent Ni) is accepted as the best material for practically all applications. Its qualities of strength are such that it generally is used for the large low pressure blades as well. The austenitic materials (for example, 20 per cent Ni, 7 per cent Cr) also have their applications where corrosive conditions are detrimental to standard materials.

Flexibility of Welding Combines S

By Everett Chapman

WELDING has had its growing pains. It is even now experiencing the early pubic twinges of those well planted seeds that are leading to an industrial revolution. And the designing engineer has been presented with a structural method the flexibility of which grants him more design freedom than he has ever had before.

It is possible today to fuse two pieces of steel together with weld metal which as deposited has the following characteristics: Tensile strength, 65,000 pounds per square inch; a ductility corresponding to an elongation in 2 inches of 30 per cent, and an endurance or fatigue limit of 24,000 pounds per square inch.

This fact carries to the engineering profession one of the most momentous challenges it has ever had to meet. This challenge will require us to recall what we know of the proper placing of materials to meet given load conditions, it will ask us what we know of factors of safety and why are they as large as they are, and it will ask us to scrutinize carefully the equations we use so faithfully, the results of which are cautiously multiplied by five or six.

In the design of machinery, engineers are tied definitely to the most difficult design requirement of all: deflection. Since machines consist of structures designed to hold in working relationship a series of mechanical movements, the structures must be rigid and unyielding. We are also confronted with vibration, impact loading and thermal stresses of a highly indeterminate nature. Therefore we are interested tremendously in the maximum stress that occurs in the structure and in the fatigue qualities of the material at the point of maximum stress. Let us combine then as design criteria the factors of endurance or service life, with the requisite rigidity for doing the job properly.

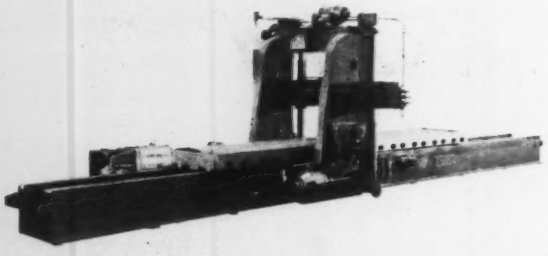


Fig. 1—Bed, table, up-rights and top tie pieces of this planer are all of welded steel. Weight saving is 33 per cent

A fatigue failure in a machine is governed by two factors: the degree of ability of the material itself to withstand repeated stresses and the existence of points at which the stress exceeds the endurance limit of the material. The responsibility is divided between these two factors. It is not only a matter of how good the metal is under fatigue loading, but also a matter of what stress exists in the metal from point to point. The responsibility for this stress value is squarely up to the designer. The writer has made some photoelastic studies on old accepted designs in which the use of the best known materials would not prevent an ultimate failure so badly was the material stressed at one or two points.

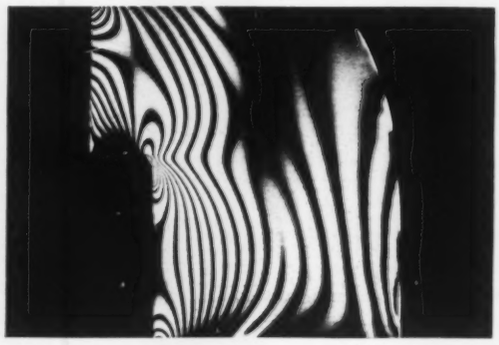


Fig. 2—Stressed celluloid model of press frame under polarized light showing stress distribution and concentration

One of the most difficult challenges offered by machine design is the stress distribution within a given structure. The engineer's greatest insurance against fatigue failure lies in the use of material which is exceedingly ductile. If the engineers of history had been working with glass-like substances there would have been considerably more failures than have been recorded. It is in this vein that emphasis is placed upon the importance of the ductility of weld metal and indeed on the ductility of parent metal embodied in a welded structure. Due to the inherent geometric character of welded assemblies, weld metal may of necessity occur at points of maximum stress. The high duc-

Strength, Lightness

tility of the weld metal available is the designer's guarantee of security at those points where factor of safety is substituted for experimental and mathematical analysis.

Box sections are the best sections that human ingenuity has been able to suggest for the resistance of stresses of a complex nature. A well designed box section is not only good in straight tension, straight compression and bending in both directions, but it also is an excellent torsion member. However, a box section under certain methods of construction involves considerable difficulty one way or another. If cast, there is the cost of cores; possibility of cores shifting with undesirable results; increased cost

GREAT masses of material in a part do not necessarily mean that the part has a correspondingly high moment of inertia. Mr. Chapman, director of research and engineering, Lukenweld Inc., points out that by the welding process weight can be added readily where it is needed, or moment of inertia increased with a reduction of weight.

on the part of the foundry; and the initial work of making the pattern.

When as engineers, we thought of using tubes as torsional stiffeners, we discarded them through commercial necessity and contented ourselves with an H or channel the sections of which were much heavier than the equivalent tube. In riveted construction we always were faced with the question of bucking up the back of the rivet and as a result most riveted construction is of the I or deep channel type.

Commercial rolling mills early discovered that tubes and boxes were more expensive to make than the open I or H section. The I or H section, as known today, is an excellent structural member for simple loads in one direction. But in design of machinery we have to resist loads and stresses from every direction. So it seems that thus far the dictates of cost in every field of mechanical construction have specified open sections rigidly and have legislated just as religiously against the use of the closed box sections.

To an engineer who has had some experience with welded possibilities, a box section soon becomes a natural reaction; the proper section to use and an inexpensive section to produce. It is possible to bend a channel of any shape and weld to it a closing flange, or bend two channel shapes and weld them together along the middle. In such fabrication, not only have economies been effected by cutting the welding in half, but in addition we have satisfied that racial phobia which since time began has associated good appearance with rounded corners and nubbins.

The question of kind of material enters into the matter of rigidity. In comparing materials cubic inch for cubic inch, that elusive conception modulus of elasticity must be taken into account, and in the person of rolled steel the commercial world knows of nothing which has a higher modulus of elasticity than shapes and plates which can be bought in the open market for two cents a pound. No commercial material is more homogeneous than these rolled plates; so stiffness as effected by porosity is higher than that of any known material.

There is a general misunderstanding extant that the principal saving involved in using a welded structure is the cost of the pattern. Industrial management must face the tremendous challenge of the divers phases of this misconception. Many of those intangibles which are lumped together and called overhead (the zoo

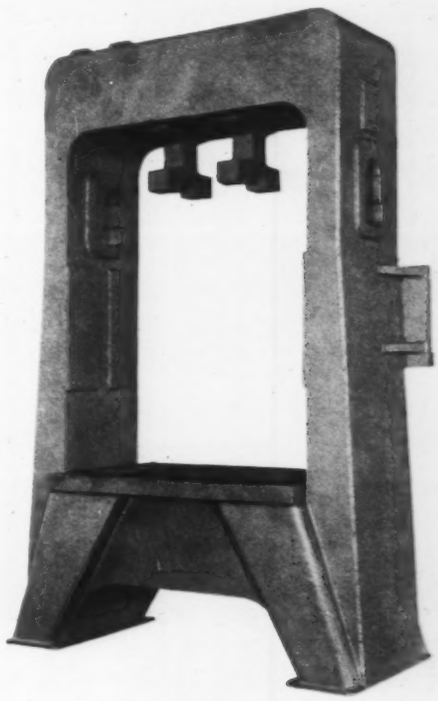


Fig. 3—Rolled shapes, torch cut and welded are used to fabricate this press frame

of modern business) are tied up in that commercial adjunct known as the pattern shed. There are real estate values involved in the space on which the patterns are stored; certain insurance rates which must be paid against the contingency of fire; that most important item, continuity of

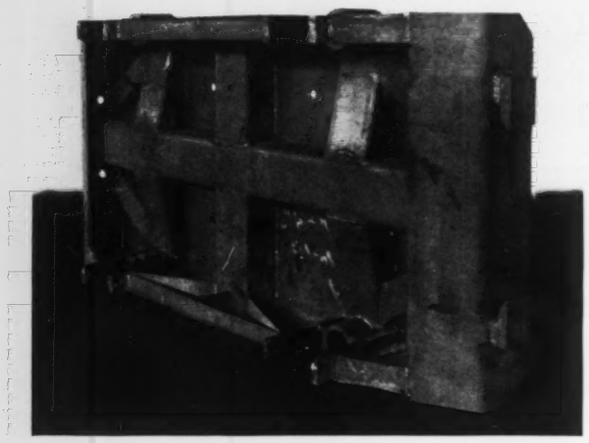


Fig. 4—Bottom view of small charging box buggy showing bent box tubular forms for beam strength and torsional rigidity

production, which fire insurance cannot possibly cover; the not inconsiderable cost of pattern upkeep, and a tacit commitment to an old and possibly obsolete design.

Welding costs today are somewhat higher per pound than the equivalent prices of cast materials. It is a rare case, however, that will not admit of a reduction in weight with which to offset this higher pound price, with the result that the single piece can be made at a price equal to or less than the cast piece. If the piece is to be produced in quantities, considerable reduction can be made in the manufacturing costs.

Several Factors Are Considered

This, of course, takes into consideration multiple gas cutting where one machine with a battery of four or five torches stacked up on its arm, will cut four or five pieces at one pass over the template; bending equipment where the cost of the press "set up" almost vanishes over a number of pieces; dies wherein subassemblies stream from the rear of a punch press; and also the effect of the similarity and uniformity of pieces coming from dies on the cost of the largest single item in a welded part-assembly.

Welding itself does not cost a great deal. By the very nature of the new paste-covered welding rods it is possible to increase the energy density at which the rods are worked and achieve perfect fusion at a great rate of speed. Many production welding methods are awaiting the quantity requirements of welded structures. Those who claim that welding is only applicable where one piece is to be built with a consequent pattern saving should note the production of the automobile body as a one-piece welded structure. The same method used to flash-weld these bodies can be applied admirably to almost any production item. If not to the whole, then to its parts.

One of the major machining economies to be effected by welding construction is the combining of parts. Practical limits to the size of a completed job are the size of the annealing furnace, the size of a flat car on which it is to be shipped, and the possible limitation offered by the manufacturer's machining equipment. In most cases these limits are much larger than the limits imposed at present and many pertinent economies can be effected by the judicious combination of machine details.

Punch Press Frame Is Example

An example of welded machine construction is presented by the frame of a large punch press subjected to a pure bending plus tension load. This frame formerly had been executed in cast steel and the cross section was a nicely designed box using 2-inch webs, a 2-inch back flange and a 6-inch front flange, while the depth of the box was 26 inches. Question: How to reduce the weight and increase the rigidity in this machine in which die alignment is an important feature? The first reaction was to take some of the metal from the ineffective webs and put it in the extremely effective flanges. A box depth of 40 inches was just as usable as the box depth of 26 inches. As this frame formerly had been cast in steel, no advantage could be taken of the relative moduli of elasticity as is the case when

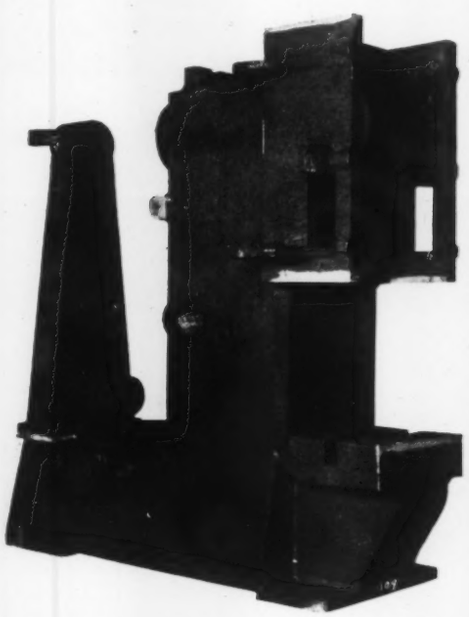


Fig. 5—Press frame in which moment of inertia was increased by proper use of design constants

substituting for gray iron. Proceeding to develop a greater moment of inertia than before, but using thin webs, thick flanges and 40-inch box depth, an increase in the moment of inertia of this cross section of about 40 per cent was obtained using 5000 pounds less metal. In deepening boxes in this manner and in thinning the webs the section moduli must be watched in order to keep the working stress at a safe value. This was done and the maximum stress as predicted by formulas and checked later by strain gages was not over 10,000 pounds per square inch at the most highly stressed point.

So much for the main design. But what is to be done in these cases about the stress concentration which can be demonstrated photoelastically at the lower corner? Fine steel is available and the weld metal is perfect, but there still is, in spite of that, a stress concentration due to the change of contour, and the best steel made will not prevent a fatigue failure at this point if the local stresses are over the endurance limit. Although the front flange of this box is a 4-inch plate, an easy change of contour can be procured by bending it to a 5-inch radius.

A block will restore the die space which was

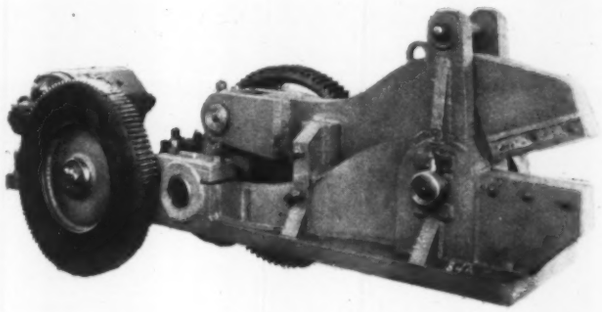


Fig. 6—Alligator shear of welded construction

lost at this radius, but the block must not be welded around the contour. We do not want to recreate the notch which we went to so much pains to eliminate. The accompanying photograph, Fig. 5, illustrates these various points. This frame is considered a successful application of the principles of welded steel design.

While the usual argument for welded construction revolves about the saving in weight, it should be pointed out that a welding can be made heavier at less cost than in any other form of construction. A case in point is the locomotive used for towing the dirigible AKRON into her hangar at Lakehurst. Specifications called for a maximum height of 6 feet and a weight of 264,000 pounds. This meant a locomotive packed nearly solid with steel. In fabricating the mount for the gasoline motor which drives the hydraulic pumps, one-inch plate was strong enough. Three-inch plate was used for weight, however, while the weld sizes were kept at the strength requirement of one inch. This extra metal in the form of rolled plate cost the manufacturer only two cents a pound.

The greatest obstacle that the engineer considering welding will have to contend with is his own difficulty in keeping down the number of component pieces that enter into the job. The cost of a welding job is about proportional to the number of pieces that go into it, and this calls on the engineering profession to become extremely simple minded. Contrary to the usual belief this can be made one of the extreme pleasures.

It is hoped that this brief summary of some of the high lights of welding may prove interesting to those of the engineering profession who see fit to accept the challenge of welded steel.

Organized Research Assumes Functions of Individual Inventor

UNTIL about 25 years ago the world looked to individual inventors to point out new paths for technical progress. The inventors had to conquer the intervening difficulties, for the most part single handed, and had to demonstrate operative mechanisms or processes in order to enlist support and get powerful organizations behind their ideas.

Now organized research has become the most fertile source of new ideas. The day of the individual inventor is passing; we are rapidly approaching or have arrived at the point where basic technical advances come as an outgrowth of painstaking analytical and experimental work, largely in the laboratories. Where once we looked to them only for tests confirming what we already knew or for help in locating and eliminating minor limitations in our technical products and processes, we now admit that they are more likely than we to open up new fields of progress.

Many of the industrial products which occupy the center of the stage now were recently born in laboratories; they were not the children of inventor's minds in the same sense as were the electric light and the steam hammer. Consider this list: Cellophane, bakelite, rayon, corrosion-resisting steels, anti-knock gasoline, irradiated foods, sound pictures, television, and the new strong alloys of aluminum.

In the future, sound technical progress will follow research. There will unquestionably appear more great inventors of the stature of a Diesel or a Sperry, but the results of extensive research will be the raw materials upon which their inventive work will be exercised.

The foregoing is abstracted from a paper presented by John P. Ferris, chief engineer, Oilgear Co., at a joint meeting of the Engineers' Society of Milwaukee, and the faculty of the College of Engineering, University of Wisconsin.

Conserving Power in Design of Automatic Stoker

By Allen F. Clark
Editorial Representative, Machine Design

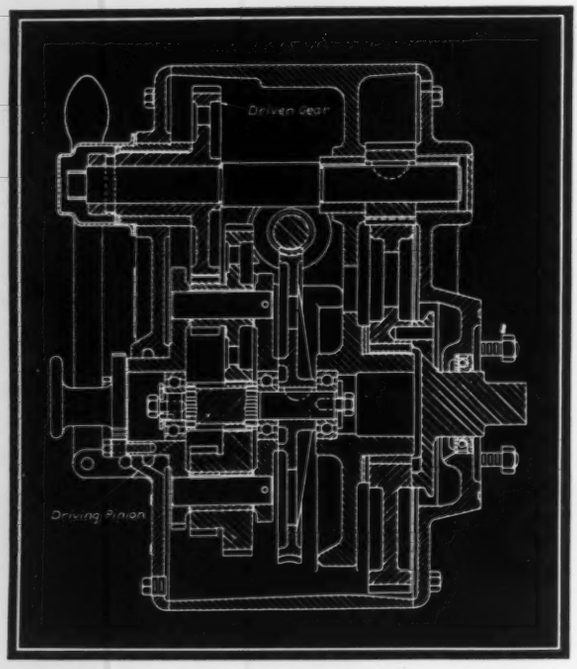


Fig. 1—Cross sectional view of transmission showing speed changing gears and the method of mounting

ISAAC NEWTON in his concise statement of the laws of motion first propounded by Galileo stated that no force is ever lost, yet every designer knows that any force expended on overcoming inertia is definitely lost as far as accomplishment of the ultimate purpose of the machine is concerned. The inertia that must be overcome when first starting a machine is one factor that always will be present, although this can be reduced considerably by careful design, use of efficient bearings and proper lubrication. Another part of the equipment, however, where a great deal of force may be lost is the transmission, where the necessity of initially starting gears during speed changes often places considerable drag on the motor.

In the design of the transmission of the automatic stoker, Fig. 2, built by Iron Fireman Mfg. Co., losses attributable to inertia of gears brought into operation for speed changes after the machine has been started have been cut to the lowest possible point in harmony with good design. Intermediate speed change gears always are in mesh with the driving pinion, thus always are rotating, and are cut with pointed teeth to minimize clashing and to facilitate engagement with the driven gear.

Speed change gears, Figs. 1 and 4, are maintained in contact with the driving pinion and shifting is simplified by mounting these gears on shafts spaced 120 degrees apart between two spiders mounted on either side of the driving pinion and on its shaft. One of the speed change gears has a pitch exactly equal to the distance between the pitch of the driving pinion and that of the driven gear. This is the highest speed gear.

The next lower speed is obtained through a larger gear which meshes with the driving pinion and has, integral with it, a smaller intermediate gear. The latter comes into contact with the driven gear when the spider is turned through 120 degrees, and thus provides a double reduction. The next and lowest speed is obtained through a still larger gear and its pinion which necessarily must be smaller in order to mesh with the driven gear.

The transmission, a compact and well designed unit, Fig. 5, receives its power through a V-belt

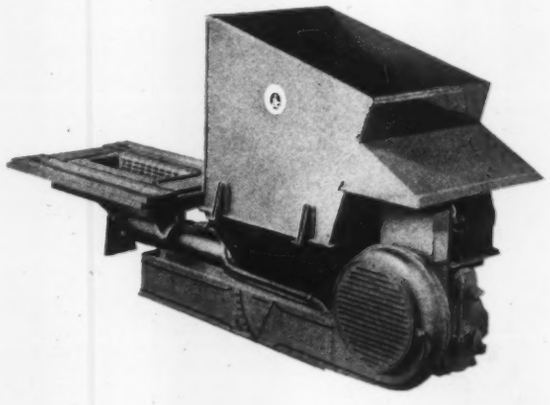


Fig. 2—Industrial stoker is operated completely by automatic controls

drive from a motor mounted on top of the cast iron housing. This motor has rubber pads under each corner to minimize vibration and noise. Power from the driven pulley passes through a worm keyed to the shaft of the pulley and a worm gear, to the shaft of which is keyed the pinion previously referred to as the driving pinion.

This transmission design supplements a rack

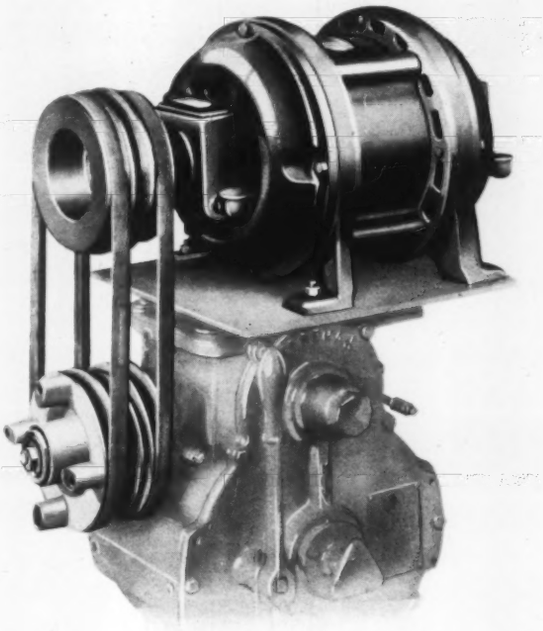


Fig. 3—Drive pulleys for fan and operating gears are arranged compactly

movement used previously which introduced considerable resistance to speed changes and consequent loss of power spent in overcoming inertia. The first thought in the new transmission was to provide four forward and one reverse speed, but as all the speeds specified were not necessary for efficient operation this design was abandoned for the simpler unit now employed.

Further Reduction Necessary

In order to adjust the speed at which the coal is fed to the furnace to the low rate necessary there is further reduction beyond the driven gear. The final gear in the transmission is connected by a flexible coupling to the feed screws for the coal.

Positioning of the gears and shifting have been reduced in difficulty to a minimum in the design because the units must be operated by laborers, women, and men who may not be mechanically minded. The position of the spiders is controlled by a lever on the front of the case which operates a pin that fits in holes in the front spider. There are six of these holes evenly spaced around the spider, three of which position the gears for one of the three speeds, while the other three are neutral positions.

Lubrication required in the transmission for ball bearings, contacting gear faces, and bronze bushings, is taken care of by the splash system; a single grade of heavy motor oil being used. This has been found to be sufficient for the wear encountered. A commercial oil seal is used on the shaft which connects to the coupling, while special red paint seals the joints between other surfaces and the joint between the back of the oil seal and its seat.

In order to simplify the drive and to eliminate parts, a dual drive from the motor is employed to operate the pulley which drives the transmission and the pulley for the fan, the latter rotating on ball bearings mounted on the shaft of the worm. By thus mounting the fan so that it rotates independently, it can be run at any speed regardless of the speed of the transmission, and its air output exactly regulated to the requirements for perfect combustion.

Vibration Is Reduced

By combining the quietness and flexibility of a V-belt drive with a fan that is balanced accurately, vibration is cut down and noise brought to the point where it is little more than that caused by the rush of air. An iris air intake regulator controls the amount of air, regulating the speed of combustion after the fashion of the damper on the ordinary furnace. The adjusting sectors of this regulator, made from corrosion resisting bronze sheet, are built as the iris diaphragm on a camera, and operate in the same manner.

Obnoxious fumes, especially in domestic units, must be eliminated if the equipment is to find

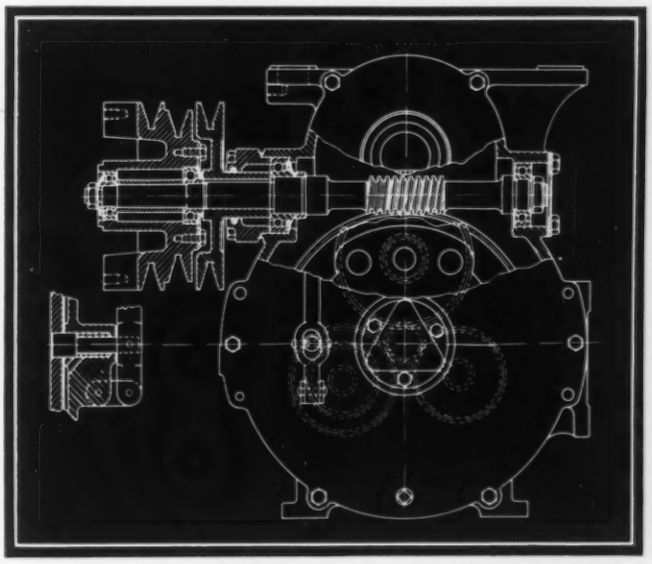


Fig. 4—Arrangement of duo-drive pulleys and three speed gears used in shifting

general acceptance. To eliminate these fumes, which might find their way back through the hopper, a small air intake is placed in the fan casing at the point at which the air leaves the fan with the greatest velocity. An air duct connects this intake to an air injector placed at the firebox end of the worm housing. As the outlet end of this tube is smaller than the intake end, a stream of high pressure air flows into the housing of the feed screw at all times, thereby creating a positive movement of coal fumes through the fuel at the bottom of the retort.

The conveyor screw is made of a special heat resisting alloy steel, and is thicker at the transmission end than at the delivery end, a design which permits the feeding of coal evenly and with a minimum expenditure of power. This conveyor floats in the housing.

Control of the stoker is effected through a motor driven relay switch which is operated by a thermostat, hot water control or pressure regulator as the conditions may require. On larger units, the relay switch operates the motor through a magnetic switch. Thermostat equipment may include an electric time and temperature control that adjusts the heating value to different quantities at predetermined hours.

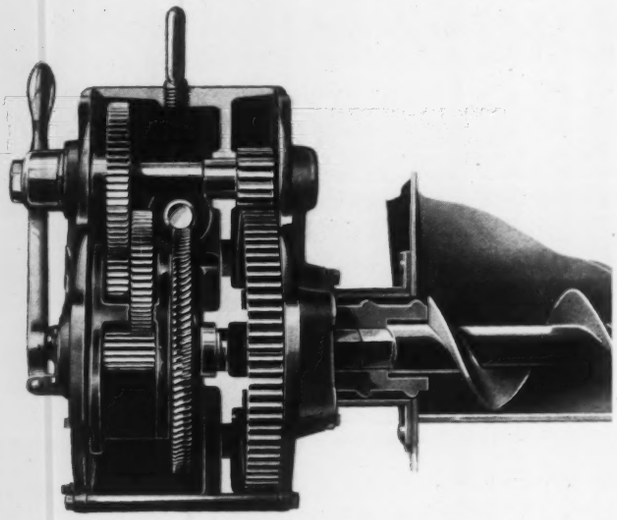


Fig. 5—Stoker transmission permits easy shifting and eliminates clash of gears

Pressed steel parts and fabrication by welding have come into increasing use in the design of this stoker, both to improve its appearance, simplify fabrication difficulties and insure homogeneity of structure. Spot welding is employed for some of the parts, while oxyacetylene and electric arc welding both have their place. The oxyacetylene process is used to fabricate the thinner sheets, while on sheets 14 gage and over the electric arc process has been found to be the best for the purpose.

Is Design Influenced Unduly by Production?

By Robert F. Elder

DESIGN of most manufactured products on the market today is influenced over-largely by tradition. Today's products pattern themselves on yesterday's ideas of what they should look like, and often neglect changes in their purposes or the conditions under which they are used. This is a matter of inertia. The easiest course is to assume that past success guarantees future success. The usual position of the design function, fairly low in the organization, emphasizes this inertia. Sad to relate, the radical improvements in an industry's product usually have come from entrepreneurs outside its ranks and unhampered by its traditions.

Nevertheless, it must be granted that a policy of conservatism has certain advantages. The consumer himself tends to be slow in his acceptance of things which differ too radically from those to which he has been accustomed. The enthusiast for change is likely to overstep the bounds of customer acceptance. And it may be argued fairly that it is better to continue in the old way than to venture into new designs without adequate knowledge of what the market really wants.

Obsolescence Policies Important

Design likewise is influenced unduly by existing investments in manufacturing equipment. Reluctance to scrap equipment which still is physically useful too often affects decisions on design. This is due largely to inadequate obsolescence policies which fail to recognize that the cost of equipment should be amortized during the period of consumer demand. Another impediment to timely changes in design is to be found in the undoubted overinvestment in highly specialized single-purpose machinery resulting from the philosophy which regarded the consumer as an adjunct to the process of mass production, rather than the end to which the entire process was designed.

Manufacturing processes too often determine the appearance and specifications of the product. In most plants the individual in charge of design is more familiar with the technique of production than he is with either abstract principles of design or the requirements of the product's ultimate users. When the sales department, which first senses consumer dissatisfaction through reduced volume or increased difficulty in selling, calls for changes, the changes which

are made are only such as can be made within the limitations of the existing manufacturing process or at least with only minor alterations. From the standpoint of the designer and the production department it must in fairness be recognized that the sales department is seldom able to specify just what it wants in the altered product.

This analysis reveals clearly that the problem involved is two-fold. It is necessary to develop means for ascertaining with some degree of precision what consumers' real wants are, in order that they may be anticipated correctly by manufacturers. Given ways to know what consumers' wants are, the organization should be so set up as to be able to translate them into production in an economical fashion. Both are difficult tasks. The first is perhaps the more difficult, but there is ample evidence that it can be accomplished. The second clearly involves separating the design from its exclusive contact with production and recognizing it as a major problem of the business.

This, of course, is much more than a question of organization structure. It involves the difficult problem of proper personnel. The man who is charged with the responsibility of keeping the design of the product in harmony with market requirements must be a many-sided individual. He must be a keen student of the underlying trends of modern life, with sufficient imagination to realize their import to his own business. He must be sufficiently sales-minded to distinguish between those improvements which consumers would like and those for which they will pay. He must be thoroughly acquainted with modern manufacturing processes and materials, their possibilities and their limitations. He must be a man of vision, not hampered by traditional limitations, but not a visionary who refuses to recognize practical considerations. Our industrial development has not been such as to produce many such men. Our engineering education has not been such as to turn out many men properly equipped for such jobs. Yet with the increasing importance of proper design it is imperative that we find them or develop them.

The designer must be well informed on how the consumer buys and uses the product and what are the factors which influence him in his choice. To an increasing degree the design function is coming under the control of the advertising agency. While this is perhaps a good thing as far as salability is concerned, it unfortunately often results in products which are somewhat inferior from the engineering point of view, and in failure to achieve the maximum economies in production.

The designer of a product also must go beyond the consumer's expressions on the subject of likes and dislikes and anticipate wants which are still latent. The difficulties of using an engineering approach to a problem with so many intangibles has led many companies to dependence on the genius or intuitive sense of "stylists." This new profession has the usual quota of quackery found in any new field. But the people who have really achieved significant and consistent success in designing salable products have generally used methods not at all inconsistent with the engineer approach.

The market for industrial machinery depends on the demand for the products of that machinery. Changes in the design of the product sold to consumers mean, very likely, changes in the machinery which makes the product. The machinery manufacturer who can sense coming changes in design of the products made with his machinery enjoys a decided time advantage over his competitor who waits until his customers bring their problems to him. Even the producer serving the industrial field, then, has a material interest in watching the trends of consumer demand and translating those trends into design.

Design cannot be delegated to people unacquainted with production processes. Still less, however, can it be left to people who fail to realize the problems and needs of the consumers from whom profits must in the last analysis come. The ideal solution is the development of a type of engineer who can visualize and correlate problems of both consumption and production. We have all too few of such men. The answer is simple. Train your designer in production methods, but make them understand that methods and processes are their servants, not their masters. Keep them in touch, as directly as possible, with your ultimate customers. Let them realize the importance of the product in the selling scheme. Then revamp your organization so as to bridge the gap between the requirements of the market and the factory.

OBSOLETE or inferior design, or design that is not ahead of the trend in consumer demand rather than following docilely behind, places a terrific handicap on the sales department particularly, and indirectly on every phase of the organization. Some of the factors that might contribute to such a condition, and methods which management may well employ to avoid this handicap are given in this abstract of a paper which Mr. Elder, assistant professor of marketing, Massachusetts Institute of Technology, presented at the recent Mechanical Engineers' Three-M congress in Detroit.

Editorial

Is Present Training of Engineers Too Narrow in Scope?

IMPRESSED by the clamor for humanizing engineering education, a few members of the faculty of the college of engineering of Ohio State university decided to obtain the views of representative business leaders on this subject. They submitted questionnaires to executives, most of whom were chairmen or presidents of corporations having annual sales above $10,000,000. Replies from 97 were received.

One of the questions pertaining to engineering education read as follows: "Is more cultural training and a wider social outlook needed?" To this query 81 industrial leaders answered "yes" without reservations, five replied "not needed but helpful," four wrote "no," and seven failed to answer.

The executives also were asked, "What subjects aside from strictly technical ones would you deem it wise to include in engineering curricula?" In the replies, economics led with 42 votes, history was second with 25, English third with 23, psychology fourth with 18, and business administration and public speaking were tied for fifth place with 16 each. Other subjects received only scattered votes.

The result of this investigation seems to indicate that business men—employers of engineering service—agree almost unanimously that engineers should be trained to understand and appreciate the social and economic implications of their work. This point has been emphasized time and time again in MACHINE DESIGN by contributors to the present series of letters pertaining to the relations of engineers. It is gratifying, therefore, to be able to present such weighty corroborative opinion as that revealed in the Ohio State survey.

Noise Creates Inefficiency

IS SUFFICIENT attention being paid to noise elimination in machinery? That there is a trend in this direction is evident, not only from observation but from such signs as the heavy demand for a recent book dealing in part with quietness in machine operation.

For some years research work at one of the larger universities has been directed specifically at noise testing and elimination. More recently the initiation of a project on noise measurement has been approved by the standards council of the American Standards association. And as a further sign of increasing activity in the subject, several units have been developed for detecting, locating and measuring noise.

A series of articles supplementing data published in MACHINE DESIGN is planned for subsequent issues, which it is anticipated will go far in assisting to combat further this bugbear of present-day high speed machines.

Henry Bessemer

Master Designers

Henry Bessemer

KNOWLEDGE of a great many things without specialized proficiency in any one is said to be an undesirable condition, yet it was just this diversified knowledge that enabled Sir Henry Bessemer to make innumerable contributions to the advancement of science. The most important of his inventions was the development of his process for manufacturing steel, which was undertaken at a time when he had only the most elementary knowledge of metallurgy.

BESSEMER'S natural mechanical ability, his curiosity and his persistence were of great benefit. He was wide awake and well versed in mechanics and chemistry. The very lack of detailed information on any one problem often proved a blessing as it permitted him to proceed unhampered by the cognizance of other's failures. Some of the processes for which he developed machinery and some of the machines to which he made contributions are:

Type-setting
Sawing plumbago
Rolling glass
Automatic stoking
Centrifugal pumps
Nonrolling ships
Hydraulic presses
Diamond polishing
Ventilating mines
Rifled projectiles
Embossing velvet
Grinding plate glass
Making bronze powder
Railway axles and brakes
Extracting sugar cane juice
Railway engines and carriages
Screw propellers, cranks and propeller shafts
Pressing, molding, shaping, shearing and cutting metallic and other substances.

THE early invention of machinery for making bronze powder gave Bessemer a financial stability that permitted extended research. This man, born in Charlton, England, in 1813, was granted 120 patents; for a forty-year period he obtained patents every year except one. His steel making process brought him honors from many countries and knighthood from his own. Although not everything he attempted was a success, his life was full of achievements in invention, development, manufacturing and marketing, all brought about by the application of a strong will that would not be defeated and intense concentration over long periods of time.

PROFESSIONAL VIEWPOINTS

Publication of letters does not necessarily imply that MACHINE DESIGN *supports the views expressed*

Comments and Questions from Our Readers. Machine Design Will Pay for Letters or Solutions to Problems Suitable for Publication

Torsional Deflection of Shafting

To the Editor:

ALTHOUGH a number of charts have been published showing torsional deflection of shafting, I believe the one shown on page 54 is unique in that it gives, quickly and accurately, the deflection in degrees and minutes per foot through a large range of values of the different variables. Other values than those shown on the chart can be assumed in the same manner as in slide rule computations. In that way the chart will cover an infinite number of possible conditions.

To illustrate the above statement, take the example shown; i.e., a 2-inch diameter shaft 1 foot long to deliver 10 horsepower running at 1000 revolutions per minute; to find the deflection. Draw a line from 1000 on R through 2 on D to pivot, thence through d to 10 on HP and find 0.0229.

In addition, assume the R value as 100 instead of 1000 using the same lines. The result in deflection then would be 10 times as great or 0.229. Of course the chart is equally effective in finding any one variable if the other three are given or assumed.

Gives Maximum Deflections

The usual practice is to allow a deflection of 6 minutes or 0.10 degree per foot length of shaft for ordinary service with no violent fluctuations, 5 minutes or 0.083 degrees for fluctuating loads, and 3 minutes or 0.05 degrees for sudden reversal of full load for long shafts and machine tools. For machine tool work the total torsional deflection of the entire system to any spindle should not exceed one degree.

The formula used in preparing this chart is derived from:

$$\text{Deflection or } d = \frac{583.6\ T\ L}{D^4\ G}$$

where

T = Twisting moment in inch pounds
L = Length of shaft in inches
G = Torsional modulus of elasticity = 12,000,000

But

$$T = \frac{63025 \times HP}{R}$$

Therefore

$$D = \frac{583.6 \times 63025 \times HP \times 12}{D^4 \times 12{,}000{,}000 \times R} = \frac{36.7813\ HP}{R\ D^4}$$

—P. R. GUIRL,
Rockford, Ill.

Let's Respect Unfinished Drawings

To the Editor:

THE viewpoint of Mr. J. M. Murphy in the March issue certainly hits the nail on the head. This does not apply necessarily to the president or general manager alone but also to the chief engineer, who must have taken pride himself years ago in turning out a good looking drawing. Why should he now wield a soft lead pencil, which makes marks so black that they are difficult and well nigh impossible to remove?

If a free hand sketch that must be erased later to make room for the rest of the finished drawing is made on the layout, nine chances out of ten the idea will take a different shape in the final design. It may be necessary to refer to this particular idea later and if it is not available it will cast a sense of apparent irresponsibility and lack of interest on the designer's ability for filing his notes.

—F. A. FIRNHABER,
Waynesboro, Pa.

SEVENTEEN United States senators led by Senator Hiram Johnson of California are on the science honor roll, according to *Science Service*. This statesman recently made an attempt to cut prohibition enforcement funds in order that, under the economy program of congress, the activities of the bureau of standards and other scientific research bureaus in the government might not be curtailed.

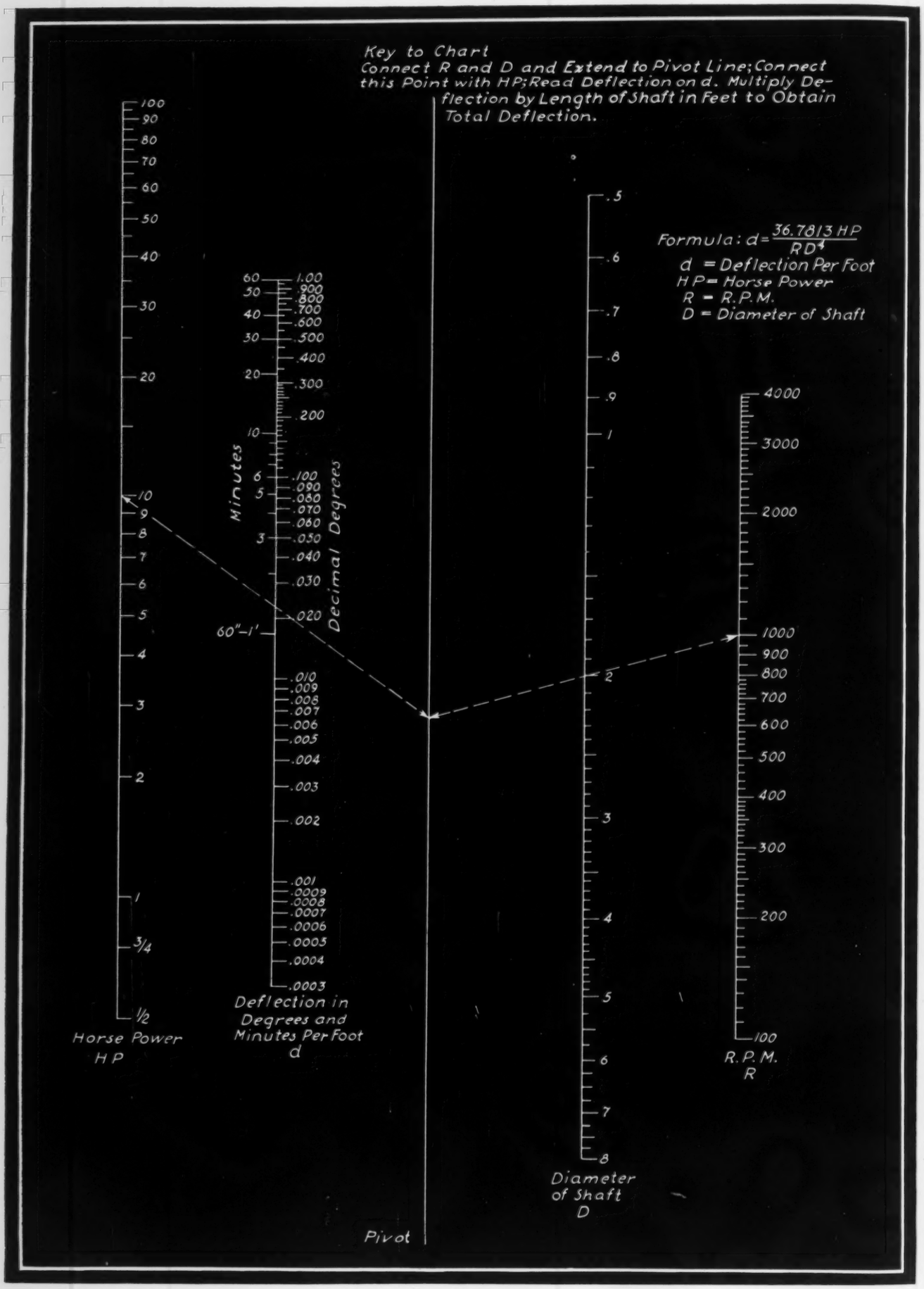

Key to Chart
Connect R and D and Extend to Pivot Line; Connect this Point with HP; Read Deflection on d. Multiply Deflection by Length of Shaft in Feet to Obtain Total Deflection.
Formula: $d = \frac{36.7813\ HP}{RD^4}$
d = Deflection Per Foot
HP = Horse Power
R = R.P.M.
D = Diameter of Shaft
Horse Power HP
Minutes
Decimal Degrees
60"–1'
Deflection in Degrees and Minutes Per Foot d
Diameter of Shaft D
R.P.M. R
Pivot

Chart showing torsional deflection for each foot of shafting as developed by the formulas derived and explained in the article on page 53. The chart covers an infinite number of conditions

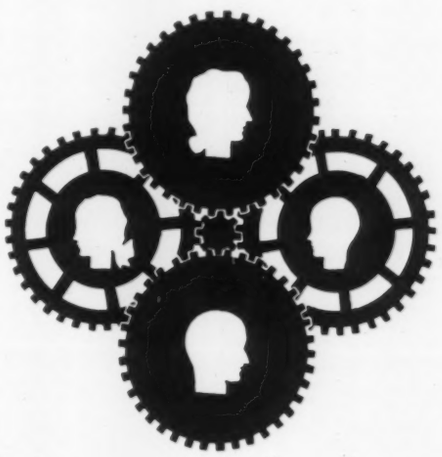
Shaping Products to the Market

"Consumer Engineering," by Roy Sheldon and Egmont Arens—Reviewed by Harold B. Veith

CONSUMPTION . . . the ultimate criterion of design. Machines, like all commodities, are subject to test, and regardless of the ingenuity employed in their conception success lies in the degree of acceptance by the market. Out of this situation has grown a new business technique known as "consumer engineering," and it is on this subject that a book bearing that title has been written.

As expressed in the introduction by Earnest Elmo Calkins, originator of the term, consumer engineering is the development of products to fit more exactly the consumers' needs or tastes. This is precisely what the design engineer is being called upon to do today, assisted by production and marketing staffs of organizations.

The authors have set out to impress on the reader the need for even greater apprehension of ways and means to build business. They cite numerous actual experiences of manufacturers in nearly every type of field in redesigning their products and changing their thinking to meet consumers' needs and desires. The application of the idea of progressive obsolescence and the stimulation of consumption through fashion promotion is applied suggestively to numerous commodities. Industrial styling is described in relation to the logical future development.



Considering the book from the exclusive viewpoint of a manufacturer of machinery, it will be found that the greater part of the material has a bearing in one way or another on the design of new mechanical equipment. Even where packaging is discussed, the designer of that class of machinery comes into the picture inasmuch as new trends necessitate improved manufacturing facilities for quantity production. One of the impressive statements in this connection is to the effect that as long as we believe our ailment is overproduction we are at a standstill. Here it is interesting to revert to a quotation from the introduction:

"We might go so far as to say that every home after being adequately supplied with shelter, food and clothing, is entitled to possess an oil burner, bathroom, car, iceless refrigerator, vacuum cleaners, radio, to mention a few of the novelties which are becoming standard. There still are multitudes who want these things, and it is the problem of business to see that they get them, by making the goods desirable and supplying the means to buy them."

The volume makes a timely appearance. Creating customers demands considerable scientific skill but it can be done. This would, the authors bring out, include among other things a steady rise in the standards of living . . . which after all is one of the most important factors in stimulating the individual's desire to buy.

Market research gets a share of the discussion and is outlined. It is summarized as: Definining the object of the survey, choosing the sources of information, selecting a location which is truly representative, planning the questionnaire or interview, testing it to see that it gets reliable answers, applying it to the chosen location, getting the information in the form of answers, tabulating, co-ordinating and interpreting the facts. One instance cited to show the effectiveness of surveys concerns a toy maker who found that his falling market was due to the flimsiness of his product. The survey he made also disclosed that safety appealed to parents. Similar procedure has been utilized by many machinery builders.

Engineers will find this book worthwhile although it is somewhat general in parts. There is a distinct connection between the thoughts propounded and the paper by Robert F. Elder, an abstract of which is presented on page 48 of this issue of MACHINE DESIGN.

"Consumer Engineering" is published by Harper & Bros., New York, and may be obtained from MACHINE DESIGN for $3.50 plus postage.

MEN OF MACHINES

Personal Glimpses of Engineers, Designers, and Others Whose Activities Influence Design

ONE of the prominent engineering leaders and contributors to the progress of design is Henry E. Eberhardt who just has passed his eightieth birthday. He is to be congratulated on having reached this age while at the same time maintaining much of his earlier activity. His life not only has been long but it also has been fruitful.

Graduating from grammar school at the age of 13, Mr. Eberhardt immediately started to serve an apprenticeship with Ezra Gould Machine Co., later becoming one of the partners of the firm. In 1904 he severed his connection with the organization and with his five sons formed the Newark Gear Cutting Machine Co., of which he is president.

Mr. Eberhardt has been granted many patents on machine tools, particularly on gear cutters and shapers; he also has been active in the development of printing machines for producing United States bank notes. He early saw the advantages of long narrow guides to stop slides from cocking, and of the provision of facilities for changing feeds on gear cutters and drill presses regardless of speed.

The design of automatic machinery is the chief hobby of Mr. Eberhardt. His affiliations include the American Gear Manufacturers association, of which he is a director.

INVITED guests for the recent patent office opening ceremonies included John J. Carty who, at the time of his retirement in 1930, was vice president of the American Telephone & Telegraph Co. His experience in telephonic engineering dates back to 1879 when at the age of 18 he joined the Bell organization. After early training in the design, construction, maintenance and operation of telephone systems in and around Boston and with Western Electric Co. in New York, he became, in 1889, chief engineer of the New York Telephone Co. In 1907 he took a similar position with the American Telephone & Telegraph Co.

Mr. Carty's personal contributions to telephonic engineering have been notable, having designed and installed the first multiple switchboard. Later he was the first to show how to operate two or more telephone transmitters from a single source of electric supply. Mr. Carty early recognized that the work to be done required a technical organization, and the large central research and engineering staff of the Bell system is a direct result of his pioneering.

At the outbreak of the World war he was ordered to active duty as a major in the signal corps, where he saw active service in France and rapidly arose to the rank of brigadier general.

LIKE his predecessors, George Paull Torrence, newly elected president of Link-Belt Co., Chicago, is a graduate engineer. Purdue university is his alma mater, from which he obtained his degree in 1908. After a year in Arkansas with the Ayer & Lord Co., and a two-year shop apprentice course in the Pittsburgh shops of Westinghouse Air Brake Co., Mr. Torrence joined the Link-Belt organization as a sales engineer.

Twenty-one years of experience in the various departments of the company which he now heads has endowed him with an invaluable engineering, manufacturing and merchandising experience. During seven of these years he was in charge of research and engineering activities carrying out his managerial duties at the company's two plants in Indianapolis.

In 1928, three years after he was made manager of both the Ewart and Dodge plants, he was made vice president of the company, remaining in Indianapolis. His next step was the presidency with headquarters in the executive offices in Chicago. Mr. Torrence is a member of the Alpha Tau Omega and Tau Beta Pi fraternities, the latter an honorary body. He also is affiliated with the University club of Chicago.

WORK of Leo Hendrik Baekeland in his development of synthetic phenol resinoids is a notable engineering achievement. It was only natural that Dr. Baekeland would be one of the honored guests at the recent opening of the new patent office in Washington. Honor upon honor has been bestowed upon this veteran inventor and his activities form an enviable record.

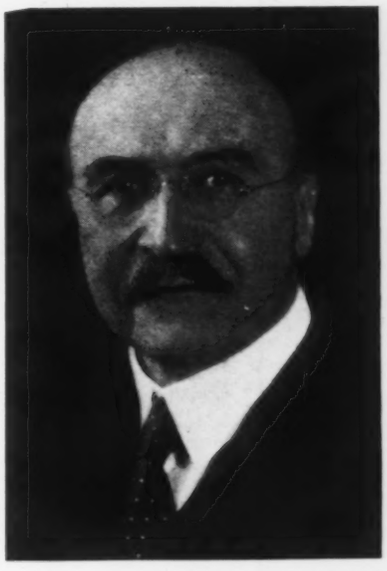
Dr. Baekeland was born in Ghent, Belgium, where he studied at the Royal Athenum and later at the University of Ghent, graduating as

Leaders in Design, Engineering and Research

HENRY E. EBERHARDT

JOHN J. CARTY

GEORGE P. TORRENCE



Underwood & Underwood

LEO H. BAEKELAND

a doctor in natural science. He became assistant and subsequently associate professor at the university and also professor at the government normal school in Bruges. In 1889 he came to America, becoming active as a research chemist.

The interval between 1893, when he founded the Nepara Chemical Co., Yonkers, N. Y., until 1906, was crowded with concentrated efforts in research. It was in the latter year that Dr. Baekeland undertook a new line of endeavor which resulted in his invention of bakelite materials, synthetic phenol resinoids obtained by action of phenols upon aldehydes. This probably should be considered his leading work.

At least five times a medalist, president of the Inventors' Guild in 1914, past president of the American Chemical Society and American Electrochemical society, honorary professor at Columbia university, a member of the U. S. Naval Consulting board since 1915, and a member of the National Research council, Dr. Baekeland's contributions to engineering progress have been accorded the highest recognition in the profession.

* * *

Carl Edward Johansson has been awarded the John Ericsson medal by the American Society of Swedish Engineers in recognition of his inventions and apparatus which accurately measures two and a half ten-millionths of an inch. He now is connected with Ford Motor Co., Dearborn, Mich.

* * *

Walter DeFries who recently has been in charge of engineering of steel plate construction, modernizing designs of special steel mill equipment including hot metal handling, for the William B. Pollock Co., Youngstown, O., now is associated with Pittsburgh Steel Foundry Corp., Glassport, Pa.

* * *

Major General George O. Squier, noted inventor and former head of the Air Forces, U. S. Army, is honorary chairman of the fourth International Patent exposition being held May 10-28 in Grand Central Palace, New York.

* * *

Robert T. Walker, assistant to William B. Mayo, chief engineer of Ford Motor Co., has resigned after 18 years with the company. Mr. Walker for many years was associated with the airplane division.

* * *

Alfred Leroy Atherton has been named to head a new metal tank mercury arc rectifier division within the circuit breaker engineering department of the Westinghouse Electric & Mfg. Co. Atherton has been identified with the miscellaneous engineering department and has been engineer in charge of the rectifier development at Westinghouse.

* * *

A. E. Ballin has become associated with the Nordberg Mfg. Co., Milwaukee, as vice president in charge of sales and engineering. Until recently he was president of the McIntosh-Seymour Corp., Auburn, N. Y.

* * *

Henry W. Sweet now is affiliated with Auburn Automobile Co., Auburn, Ind., formerly having been chief engineer of Krohn Differential Corp., Buchanan, Mich.

* * *

Leon V. Quigley has established his own business on public relations in New York. For some years he held the position of technical editor, Bakelite Corp.

* * *

D. Anson Marston, dean of engineering, Iowa State College, Ames, Iowa, will retire from his administrative duties June 30. He will be succeeded by Prof. T. R. Agg, assistant dean of engineering.

* * *

E. J. Lees, who has been associated with the Lees-Bradner Co., Cleveland, manufacturer of gear-making machinery, since its organization, has severed his connection with that company and is now affiliated with the National Tool Co., Cleveland, as engineer.

* * *

John P. Ferris, chief engineer of Oilgear Co., Milwaukee, has been elected assistant secretary of the governor's executive council and secretary of the council's committee on business economics at Madison, Wis. He was granted indefinite leave of absence to assume his new duties May 1.

* * *

J. R. Rue, managing engineer of the motor department of General Electric Co., Pittsfield, Mass., plant, has been assigned to special work at Schenectady. He has been at Pittsfield since 1912. K. R. Van Tassel, designing engineer of the same department, has been transferred to the Fort Wayne, Ind., works.

* * *

Joseph F. Foschinbaur, Oak Park, Ill., has completed 50 years with the Union Special Machine Co., Chicago, manufacturer of industrial sewing machines and accessories. Most of the time he had been in the research and experimental departments, designing and perfecting a number of types of machines.

TOPICS OF THE MONTH

A Digest of Recent Happenings of Direct Interest to the Design Profession

Cites Advantage in Machine Development

GENERAL distribution of material things and the amount of leisure we derive for the the enjoyment of them, are wholly and completely dependent upon production and machinery that enables one individual to make more units in less time, so that these many things are available for distribution to other individuals. Thus spoke George P. Torrence, new president of the Link-Belt Co., at a recent meeting of the Cincinnati section of the American Society of Mechanical Engineers.

Mr. Torrence discussed material handling machinery and its part in the future of industry. Referring to history as a basis for his address, he showed that 100 years ago considerably more than half the people in the United States were farmers. It took more than half of our population to feed themselves and to feed those engaged in other enterprises. Today about 20 per cent of our population is on the farm. With the machinery now used that amount of people produces the food required for the entire nation. If we were to take from the farmer the mechanical equipment he now uses, it would mean that we would go back to a situation in which there would not be enough people to produce the automobiles and radios we now enjoy. What we each have depends upon the total made by all.

* * *

Noise Measurement Project Approved

INITIATION of a project on noise measurement recently was approved by the Standards council of the American Standards association. The Acoustical Society of America has been designated sponsor of the project. This action was recommended to the standards association by a conference of representatives of 18 national organizations, following the request of the Acoustical society that a national committee be formed to correlate the activities of various technical and trade organizations which have been attempting individually to set up standards for noise measurement.

The scope of the project as recommended by the conference is as follows: Preparation of general standards of nomenclature, units, scales, and measurement in the field of acoustics, with special reference to noise measurements. It is expected that a sectional committee to work under the procedure of the American Standards association will be organized in the near future.

* * *

Permanent Display of Patent Models

A PERMANENT display of models of American patented inventions has been established in the commerce building at Washington. The models include those of the oldtime Gatling gun, the gun mount used on the Union warship MONITOR, many Edison inventions, the John Erickson heat engine, Bigelow carpet loom, first telegraph instrument, reaper and binder, Howe sewing machine, etc.

No more models will be available for display purposes since the practice of requiring them with patent applications was abandoned in 1880.

* * *

Laundry Machine Simplification Discussed

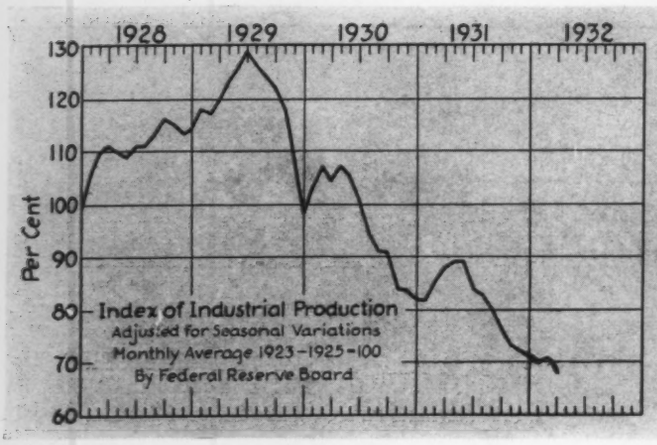
REQUESTED by the industry, a general conference recently was arranged among manufacturers, distributors, users and others to discuss the simplification of commercial laundry machinery. The meeting was held at Benjamin Franklin hotel, Philadelphia, under the auspices of the bureau of standards. Laundry machine manufacturers have been working for the past year on this simplification matter through four committees covering extractors, tumblers, ironers and washers. Recommendations were to be made on each of these types.

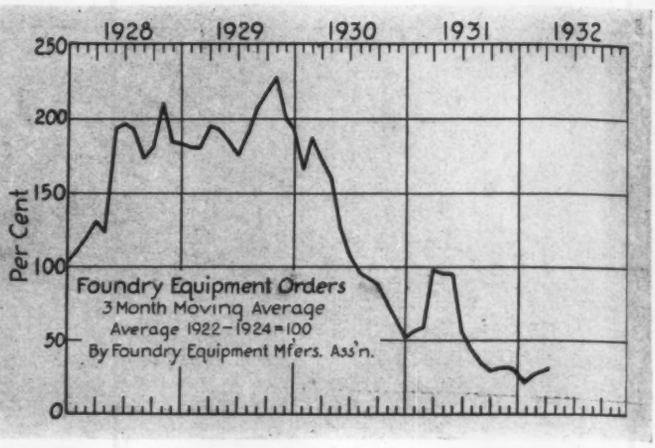
* * *

Body to Promote Scientific Development

OF INTEREST to engineers is the announcement that an international organization has been formed for general advancement and practical development of all branches of science. It has been conceived with the idea also of promoting a better understanding as to the interrelationship of the different specialized branches.

Prof. H. W. Blood Ryan, director of research, College of Pestology, London, England, is president of the organization which is called the Faculty of Sciences with offices at 29 New Oxford street, London.



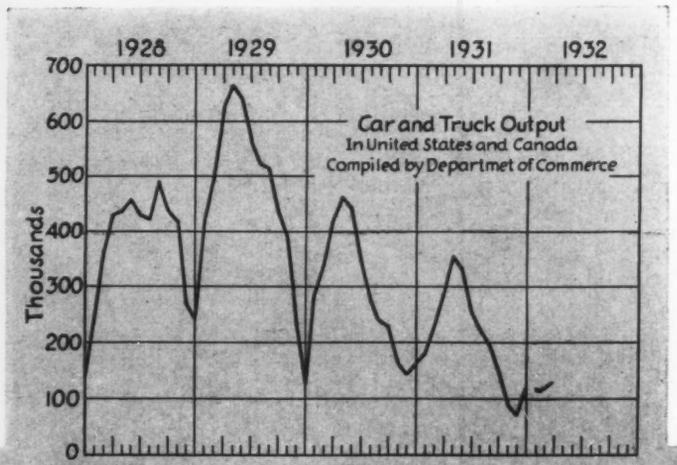


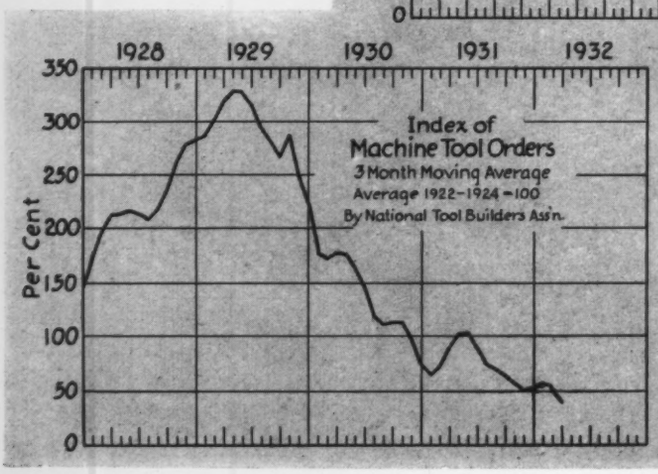
How Is Business?

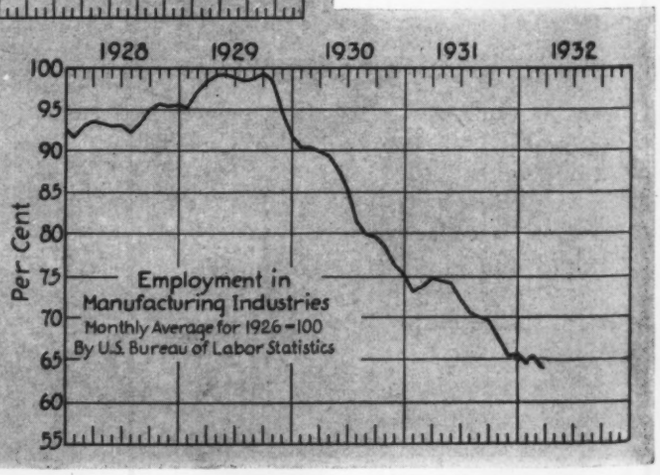
THE aggressive and intelligent merchandising methods recently employed by the automotive industry have done a great deal toward proving that there still is business to be had if the right attack and the right price are used. These sales drives will not only encourage similar procedure but also will provide an upturn in the many industries dependent upon the automotive business.

Steelmakers should be the first to feel the warming effects of the business developed, but the machine building industries should not be far behind. Just a year ago, steel operations began the slide that carried them from the high point of the year, reached only after considerable struggle, to a new low for modern times. In April of this year, operations indicated a trend towards this same procedure, but a belated spring upturn has staved off the losses. If the potent factor of automotive production can turn this reliable indicator upward, betterment throughout the summer months is assured.

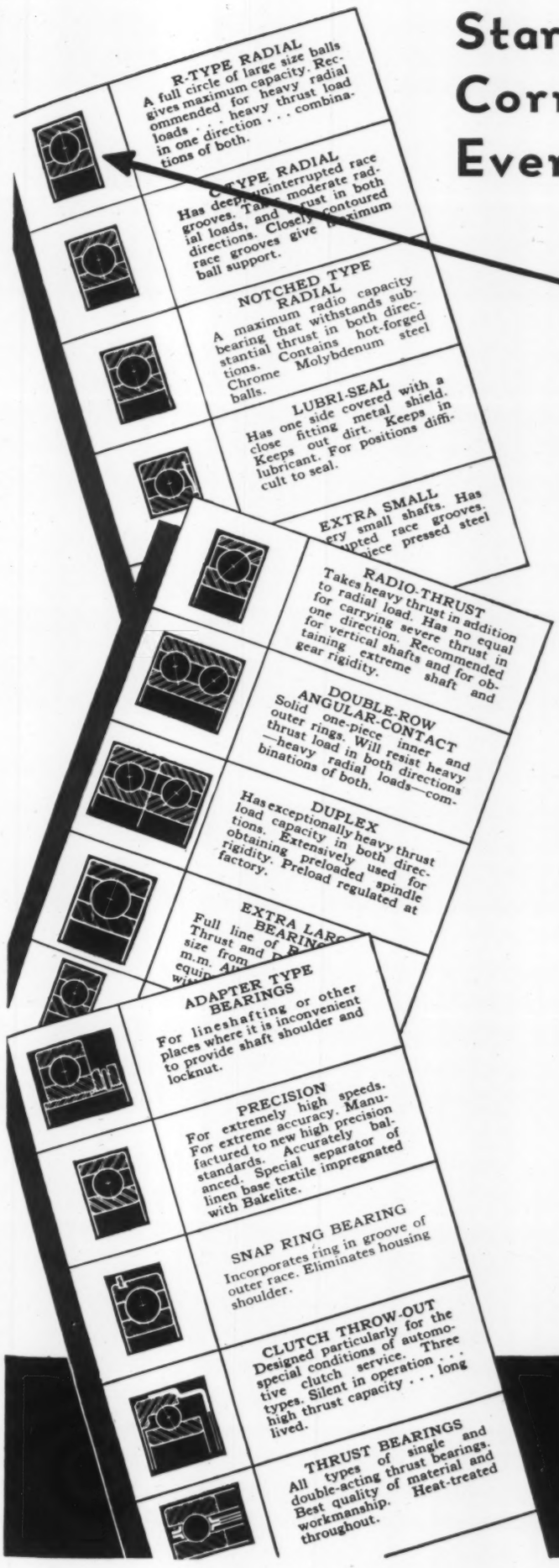
Congressional investigation of the artificial manipulation of stock prices has brought home to the commodity buying public the fact that this indicator may not be as reliable a guide to business potentialities as has been assumed. However, rearrangement of the financial picture of many companies through reduction of capitalization and similar procedure should bring earnings reports into better repute as a guide to the stability of the company concerned and to the returns to be obtained from it.

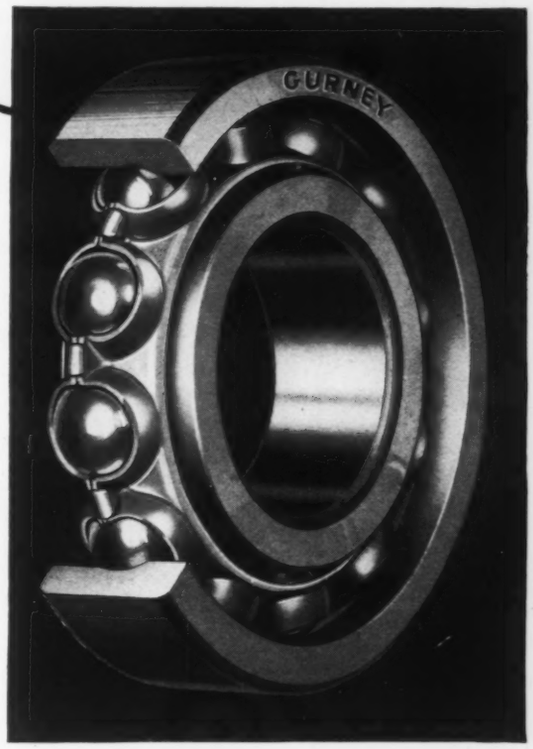






Start Right! . . Select the Correct Bearing Type for Every Application . . . .


R-TYPE RADIAL
A full circle of large size balls gives maximum capacity. Recommended for heavy radial loads . . . heavy thrust load in one direction . . . combinations of both.
TYPE RADIAL
Has deep uninterrupted race grooves. Takes moderate radial loads, and thrust in both directions. Closely contoured race grooves give maximum ball support.
NOTCHED TYPE RADIAL
A maximum radio capacity bearing that withstands substantial thrust in both directions. Contains hot-forged Chrome Molybdenum steel balls.
LUBRI-SEAL
Has one side covered with a close fitting metal shield. Keeps out dirt. Keeps in lubricant. For positions difficult to seal.
EXTRA SMALL
very small shafts. Has upted race grooves. piece pressed steel
RADIO-THRUST
Takes heavy thrust in addition to radial load. Has no equal for carrying severe thrust in one direction. Recommended for vertical shafts and for obtaining extreme shaft and gear rigidity.
DOUBLE-ROW ANGULAR-CONTACT
Solid one-piece inner and outer rings. Will resist heavy thrust load in both directions —heavy radial loads—combinations of both.
DUPLEX
Has exceptionally heavy thrust load capacity in both directions. Extensively used for obtaining preloaded spindle rigidity. Preload regulated at factory.
EXTRA LARG BEARIN
Full line of Thrust and D size from m.m. A equip wi
ADAPTER TYPE BEARINGS
For lineshafting or other places where it is inconvenient to provide shaft shoulder and locknut.
PRECISION
For extremely high speeds. For extreme accuracy. Manufactured to new high precision standards. Accurately balanced. Special separator of linen base textile impregnated with Bakelite.
SNAP RING BEARING
Incorporates ring in groove of outer race. Eliminates housing shoulder.
CLUTCH THROW-OUT
Designed particularly for the special conditions of automotive clutch service. Three types. Silent in operation . . . high thrust capacity . . . long lived.
THRUST BEARINGS
All types of single and double-acting thrust bearings. Best quality of material and workmanship. Heat-treated throughout.



THE Gurney R-Type Radial Ball Bearing is an exclusive Gurney development that has proved its dependability through 25 years of service in practically every industry. It possesses greatest possible radial load carrying capacity and a resistance to thrust in one direction greater than can be had from any other radial type.

Gurney engineers will gladly assist in selecting the correct bearing type for any application or furnish without obligation full engineering material on any of Gurney's 14 bearing types. GURNEY BALL BEARING DIVISION, Marlin-Rockwell Corporation, Jamestown, N. Y.

14 GURNEY *types*

NOTEWORTHY PATENTS

A Monthly Digest of Recently Patented Machines, Parts and Materials Pertaining to Design

MOUNTING a motor to swing in an orbital path, at the same time carrying a fast moving cutting tool on the motor spindle has eliminated the necessity for a reciprocating movement of the cutoff blade and ledger plates in a cigarette making machine. This epicyclic cigarette cutoff has been designed by J. A. Stein and W. S. MacDonald for the American Machine & Foundry Co., New York. The device, granted patent No. 1,851,334 recently, obviates vibration, excessive noise and undue wear. As the cutoff blade revolves rapidly on the motor shaft, the motor simultaneously is rotated about an axis other than its shaft, thus imparting two distinct paths of rotation to the blade which periodically strikes the cigarette rod, severing it. The blade passes through the cigarette rod at sufficient speed as not perceptibly to interrupt the forward movement of the rod in the cutoff operation.

Fig. 1 shows a top view, side and end elevation at *A*, *B* and *C*, respectively; Fig. 2, *A*, is an end elevation of the cutoff motor and blade, *B* shows the cigarette rod in the position in which it is severed. The arrangement embodies a generator 24 which provides alternating current for the motor. A horizontal arm 35 extends from the motor frame and carries insulated brushes 36 which contact with stationary metal rings 37 embedded in the insulating sleeve 38.

When the cigarette machine is running, the generator is driven by spiral gear 21 in step with the forward motion of the cigarette rod *d*, energizing the synchronous motor which thereby rotates blade 34 in exact step with the rotation of shaft 26 and the movement of the cigarette rod. Spiral gear 21 and the synchronization of the motor thus serve to bring the cutting blade in position for severing the rod at intervals which give the correct cigarette length. A support 28 carries a counterweight 31 to balance the weight of motor 27 in its orbital movement.

As shown in Fig. 1 *C*, the dotted lines represent the path of the blade about the axis of the motor and also its path of rotation about shaft 26. The cutting edge of blade is ground to the proper curve and the blade mounted obliquely so that it will pass through the rod *d* at a slight angle to perpendicular, sufficient to compensate for longitudinal movement of the rod during cutting. This oblique setting of the blade results in square cut ends on the cigarette.

By substituting an electrical drive of the cutoff blade for a mechanical drive, high speed is attained without use of high speed gearing, cam movements, etc., thereby eliminating a great deal of noise and vibration.

OF INTEREST to designers is a newly patented selecting unit incorporating an unusual arrangement of parts to test the genuine-

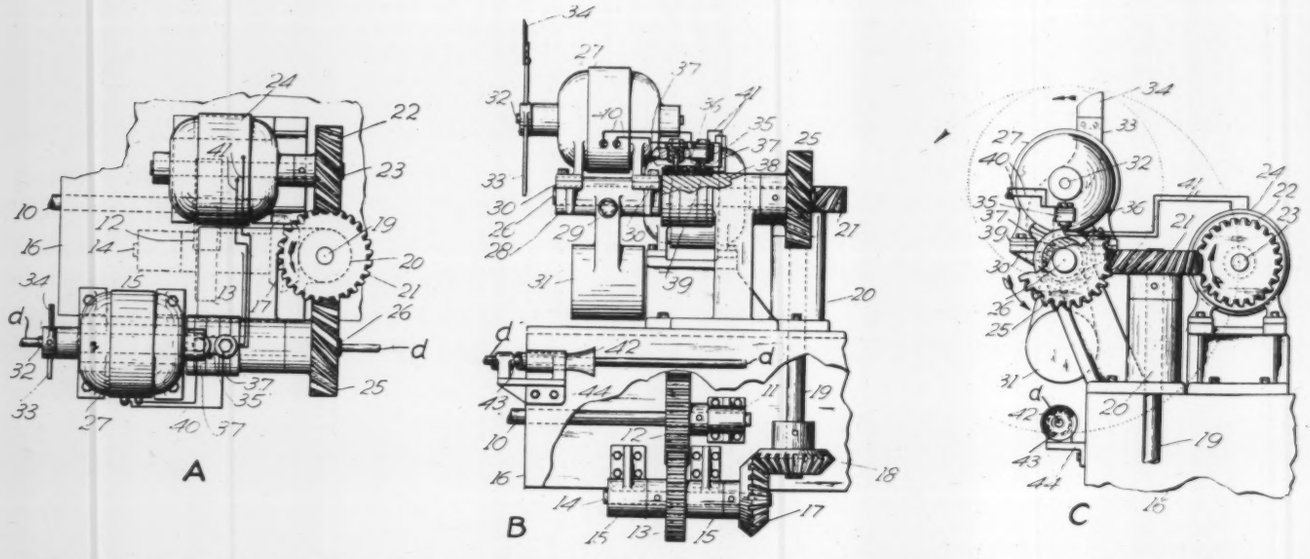


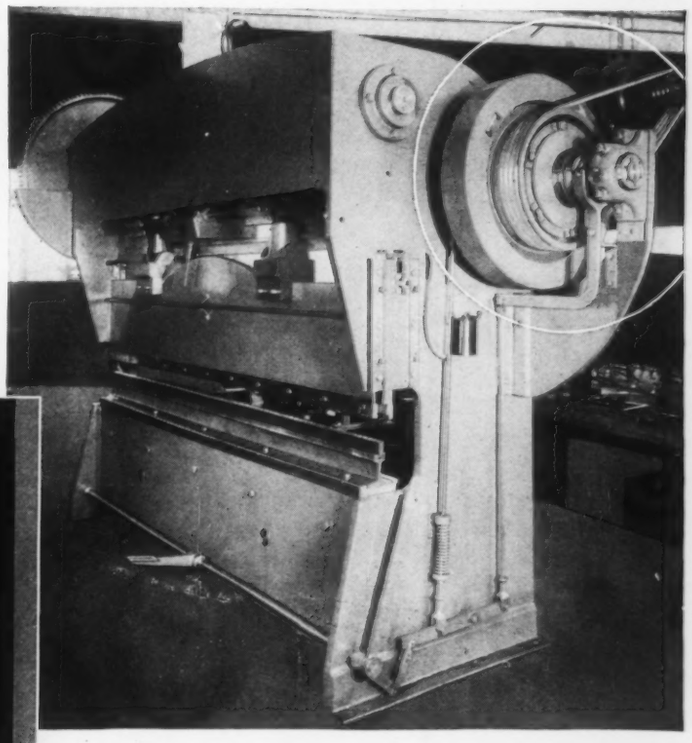
Fig. 1—Motor-operated epicyclic cigarette cutoff embodying a stationary ledger plate and obliquely set cutting blade which revolves rapidly and continuously without interrupting the forward movement of the cigarette rod

Solve Any Power Drive Problem

with

modern *Industrial* POWER DRIVE and Bearing UNITS

by



The development of a practical power drive for this machine, presented a perplexing problem.

The manufacturer's needs demanded a drive unit that could be depended on to deliver maximum power and stand the gaff of heavy duty performance.

He put it up to Dodge to solve the problem and Dodge designed and built the drive shown above which exactly fills every requirement specified.

This manufacturer came to Dodge because he knew from experience and observation that Dodge could assure him four distinct advantages.

1. A practical unit—developed by a staff of engineers with specialized power drive experience.
2. A complete unit—built in one factory from parts made together so that they will work best together.
3. A standardized unit—built with standardized parts at minimum cost consistent with high quality.
4. A dependable unit—that would minimize servicing costs and annoyances and build good will for his machine.

Avail yourself of these same advantages. If you have a power drive problem put it up to Dodge. We have the experience and facilities to achieve the solution you are seeking. Write for detailed information.

DODGE MANUFACTURING CORPORATION
MISHAWAKA, INDIANA

REG. U.S. PAT. OFF.
DODGE
MISHAWAKA

ness of coins or checks before permitting them to set the mechanism in operation. H. E. Wurzbach and Leslie H. Wadsworth, Magna, Utah, are the inventors of the device, identified by the patent office as No. 1,851,557. Selector Corp., Salt Lake City, Utah, is assignee. Vertical and transverse sections are shown in Fig. 3, *A* and *B*, respectively.

The features of the unit may best be pointed out by tracing the passage of a check through the mechanism. When the check is inserted into entrance 4 it passes down inclined passage 11, rolling over upper arm 6 of magnet 5. At this point the check is brought into close proximity to magnetic pole pieces 7, and if it is made of iron or other paramagnetic material so as to be appreciably attracted by the pole pieces, it will adhere thereto and be deflected. In the latter case the check will roll around the ends of the pole pieces and under lower arm 8 where the magnetic field is weak enough to permit the check to drop at some position to the left of dividing edge 20. The check then will roll downwardly in passage 21 and fall through passage 22, being deflected by shoulder 46 so as to enter passage 45.

Checks which are not magnetically attracted by pole pieces 7 will gather momentum in passage 11 and be projected to arm 12. If the check is materially less than proper weight it will be deflected by arm 12 and will fall to the left of dividing edge 20 as before. Checks consisting partly of iron, which are slightly affected by magnetism but insufficiently so as to be deflected into chute 21 by the magnet alone, and which are of substantially correct weight or slightly underweight, will nevertheless, be deflected into

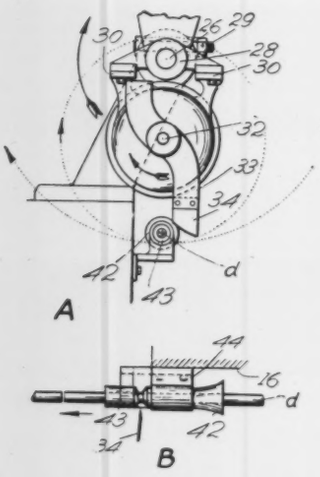


Fig. 2—At A is an end elevation of motor and cut-off blade, both of which rotate to produce the epicyclic movement indicated by the dotted lines. Cigarette rod, blade and ledger plate are shown at B

the discard chute by the combined action of the arm and magnet.

If the check, however, is of proper weight and is nonmagnetic, its momentum will be great enough to swing arm 12 out of the way, and the check will pass through space 23 into vertical passage 30. Dropping downwardly until it strikes face 31, the check rebounds against shoulder 35 and is virtually at rest when it again begins its downward course over inclined surface 32.

In passage 34 it acquires velocity and in passing through the zone of magnetic flux between pole pieces 39*a* and 39*b*, it will be more or less retarded in accordance with its magnetic properties. If the check is not spurious it will have enough velocity after leaving passage 34 to strike impact face 44. Otherwise, channel 45 will receive it. A check with the proper resilience after striking face 44 will rebound sufficiently to clear the upper edge 54 of barrier 53, and if it possesses the proper weight it will swing arm 56 aside, pass into outlet 55 and thence through chute 58 to the control mechanism of the machine.

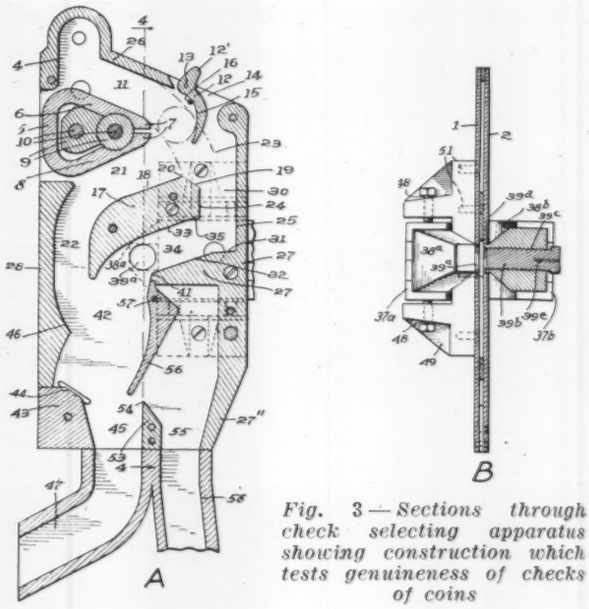


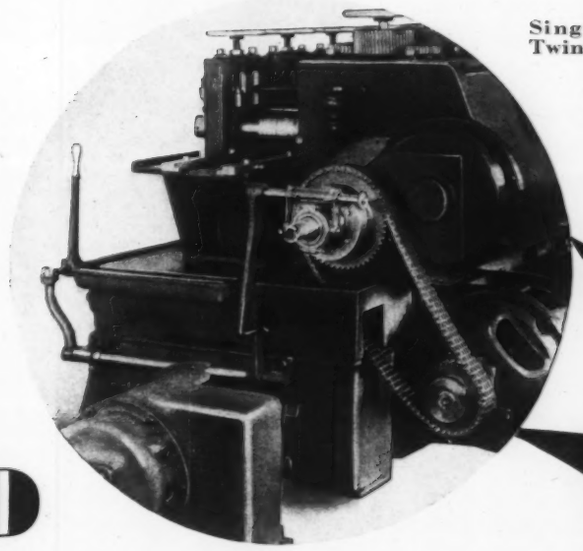
Fig. 3—Sections through check selecting apparatus showing construction which tests genuineness of checks of coins

SLIPPAGE of the ratchet mechanism to prevent rotation of the tool body when the drill steel becomes stuck and held against rotation is permitted by a newly patented arrangement designed by Barton R. Sheets. The number of the patent is 1,852,339 and Gardner-Denver Co., Denver, Colo., is assignee. Fig. 4 shows (*A*) longitudinal section of the drilling apparatus; (*B*) cross section on line 2-2 of *A*.

Embodied in the unit is a cylinder 8 in which a reciprocating piston 9 moves to effect operation and at the same time rotation of the drill steel. The rotating mechanism includes a rifle bar 10 having a slidable interfitting engagement with a nut 11 secured in the end of piston 9. This rifle bar is provided at its rear end with a ratchet head 12, *B*, which is surrounded by a ratchet ring 14 having internal teeth 15.

The ratchet head is provided with outwardly pressed pawls 16 adapted to engage the ratchet

(*Concluded on page* 74)



Single Close Coupled Type
Twin Disc Clutch, 5″ Dry Plate

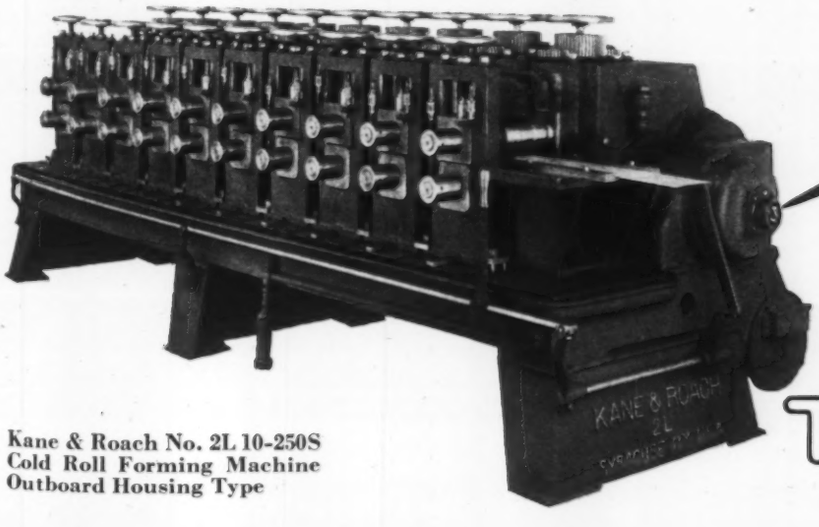
TO SPEED PRODUCTION

Kane & Roach use Twin Disc Clutches

Five sets of rolls form five distinct window sash sections, rolled to very close tolerances, at the rate of 100 feet per minute... That's speedy production! And Kane & Roach, specialists in bending, straightening and cold roll forming machinery, know that such production speed depends on easy, positive control... They have built it in with the Twin Disc Clutch—the product of *clutch specialists.*

Better designed and precision made, Twin Disc Machine Tool Clutches combine compactness with capacity... accessibility with ease of adjustment... proven durability with unfailing reliability. Thirteen years of close cooperation with leading machine tool makers in solving their clutch problems makes the advice of Twin Disc Engineers decidedly valuable to you.

Write for specific recommendations. Engineering Data Book on request. *Twin Disc Clutch Company, 1325 Racine Street, Racine, Wisconsin.*



Kane & Roach No. 2L 10-250S
Cold Roll Forming Machine
Outboard Housing Type

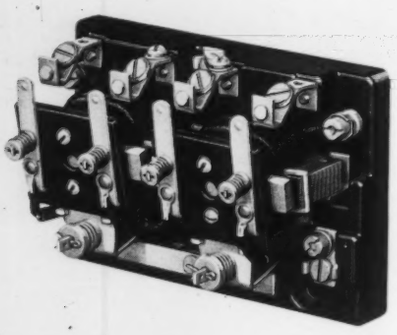
TWIN DISC
CLUTCHES

NEW MATERIALS AND PARTS

Worthy of Note by Those Engaged in the Design of Mechanisms or Machines

Small Reversing Contactors Announced

ALTERNATING current reversing contactors of small dimensions particularly adapted to small hoist, window and door control are a recent development of Industrial Controller division, Square D Co., Milwaukee. These contactors, known as Class 8711, type K, are mounted on a porcelain base, are mechanically interlocked, and have silver to silver contacts. The maximum rating is ¾ horsepower, single or three phase. Dimensions of the contactor, shown herewith, are only 6 inches wide, 4 inches high and 3¼ inches deep.



Small alternating current contactors are mechanically interlocked

Develops Small Geared Head Motors

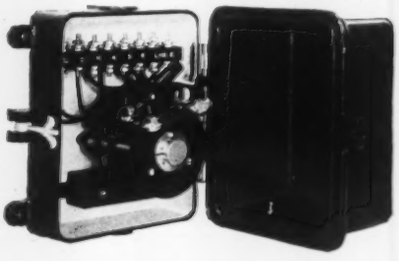
GEARED head models of the small shaded-pole induction motors recently introduced are an innovation of Barber-Colman Co., Rockford, Ill. These models, shown herewith, consist of a standard motor to which has been added a spur gear reduction. The unit will deliver a maximum torque of two pound-inches at approximately 100 revolutions per minute. Input required is 37 watts or less, depending upon which of the several models of standard motor is specified. This geared head motor is applicable to such devices as slow speed stirring machines, coffee grinders, for the operation of display turntables, for winding up fairly heavy spring motors and similar work.

The spur gear speed reduction mechanism is specially designed to provide quiet operation. Two pinions and two gears are used, the pinions being of steel and the gears of composition material. These gears are cut accurately to tolerances of 0.001-inch on runout and 0.002-inch on pitch diameter. The second, and final, driven gear has a fairly large hub in which is incorporated an oilless bearing and this gear runs on the motor shaft itself. The driven device is to be coupled to the hub of the final driven gear, preferably with a flexible coupling.

Specially designed spur gear speed reduction mechanism now is announced for small shaded-pole induction motors

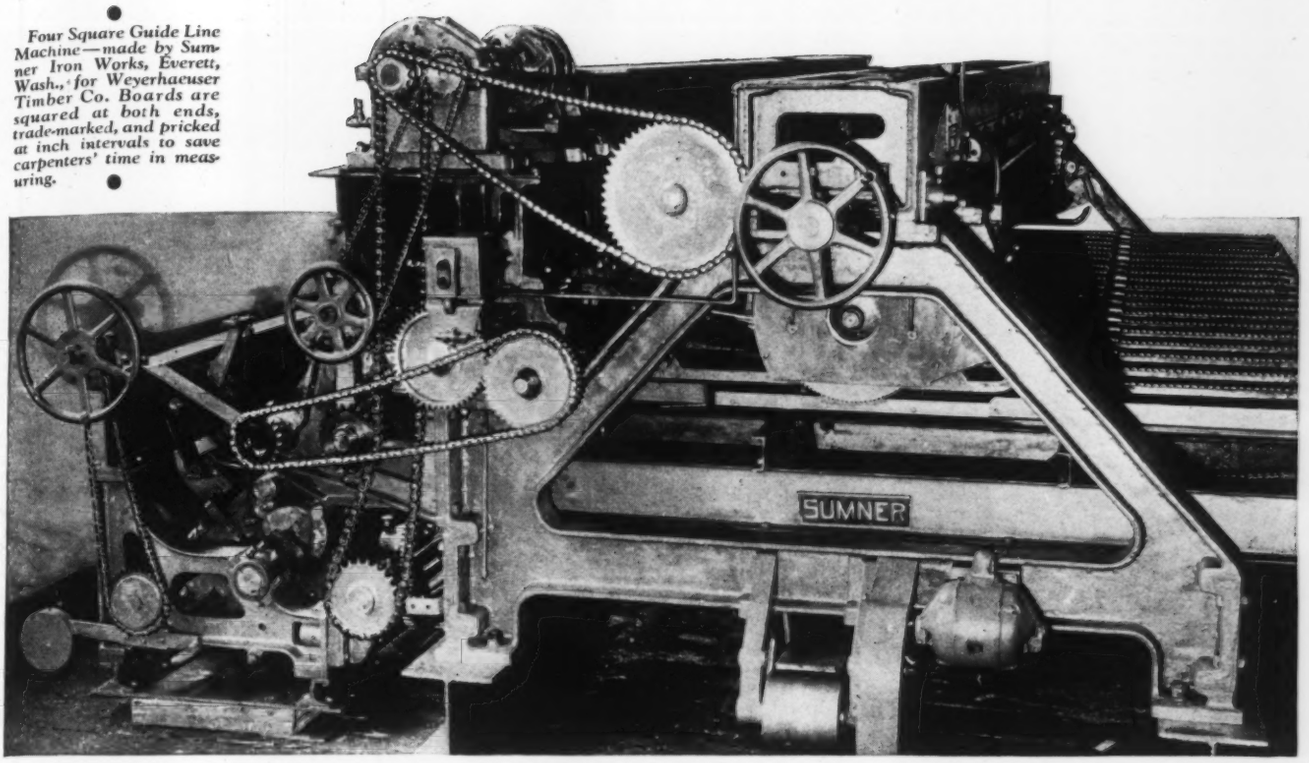
Relay Selects One of Three Circuits

DESIGNED primarily to select one of three control circuits when actuated by an instrument having sustained contacts for low and high positions only, with an intermediate no-contact position, the Motomerco relay brought out by Automatic Temperature Control Co. Inc., Philadelphia, has motor-operated mercury contact tubes and is mounted in a cast aluminum case



Motor-operated mercury contact tubes control operation of new relay

Four Square Guide Line Machine—made by Sumner Iron Works, Everett, Wash., for Weyerhaeuser Timber Co. Boards are squared at both ends, trade-marked, and pricked at inch intervals to save carpenters' time in measuring.



Speed-Ratios No Problem *with* DIAMOND ROLLER CHAIN

And They Are Permanent

"What should be the speed-ratio between these shafts—or units?" Once you answer that question, any speed-ratio problem is solved with Diamond Roller Chain. Then it is only a question of putting on two Diamond Sprockets of proper relative size, and a Diamond Roller Chain of proper capacity.

There are no problems to installing the drive. Diamond Chain runs over or under sprockets—in either direction—over long centers or short. And once the correct speed-ratio is set, it stays—absolutely cannot change.

Another problem of design simplified with Diamond Roller Chain is arrangement of units. Every unit can be placed where its function dictates—not necessity. You can drive it with Diamond anywhere.

For a complete realization of the adaptability and lower cost per year of Diamond Roller Chain Drives, mail the coupon today for the booklet 104-A "*Simplifying and Improving Machine Design.*"

CLIP THE REMINDER COUPON NOW

DIAMOND CHAIN & MFG. CO.
435 Kentucky Avenue Indianapolis, Indiana
Offices and Distributors in Principal Cities

DIAMOND ◇ DRIVES for Every Industrial Need

Quiet — Clean — More Compact per H. P. Transmitted

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Firm.....
Address.....
City..... *State*.....

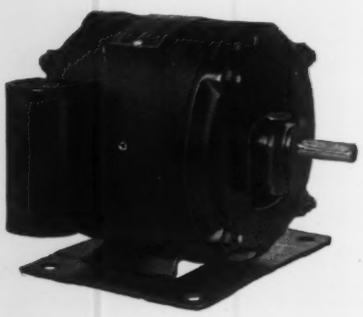
(A-636)

with hinged gasketed cover. Preferably the instrument low and high contacts should be adjustable individually to permit change in width of the intermediate no-contact or holding position to meet local conditions. The design of the relay, shown herewith, is such that it will return automatically to its mid-position and make a control circuit when the actuating instrument is at its intermediate no-contact position.

By means of the relay, it is possible to use an instrument with a single sustained contact such as a thermometer, pressure gage, etc. for operating two separate control circuits as required to function a two-position motor operated valve, thus eliminating the customary low position contact so that there is no interference with free movement of the instrument stylus and its true reading when conditions are such that the stylus is below the control setting.

Split Phase Motors Are Vibrationless

TWO new split phase motors, completely redesigned for ultra-quiet, vibrationless and cool operation have been placed on the market by Wagner Electric Corp., 6404 Plymouth avenue, St. Louis, Mo. New features of these motors include: Drip-proof endplates; liberal wool-yarn lubrication; handy conduit box adjustable in four positions; and redesigned switching mechanism on the type 44RB. This type, shown herewith, is available in 1/30 and 1/20 horsepower, and type 56RB in 1/8, 1/6 and 1/4 horsepower. Both types are available at 1725 and 1140 revolutions per minute in all cycles.

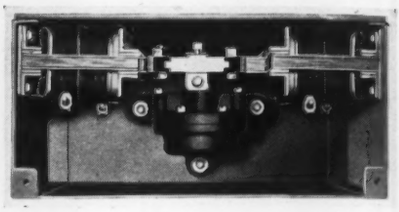


Split phase motor has been redesigned for quiet, vibrationless and trouble free operation. The type illustrated is furnished in sizes of 1/30 and 1/20 horsepower

Air Valve Operates Two Cylinders

ELECTRICALLY-OPERATED valves for 4-way control of double-acting air cylinders introduced by Hannifin Mfg. Co., 621 South Kolmar avenue, Chicago, are suitable for a wide range of applications. The model-E unit, shown herewith, provides instantaneous push button control of air cylinders from one or more stations.

The valve is operated by means of a double push button switch. Pressing the "start" button operates the cylinder in one direction and pressing "stop" button reverses the cylinder, which always is under air pressure at one end or the other. Operation is instantaneous; therefore only momentary contact of the push button is required. The circuit is closed only when one of the push buttons is depressed. This valve also may be arranged for automatic time cycle operation by means of an automatic time switch.

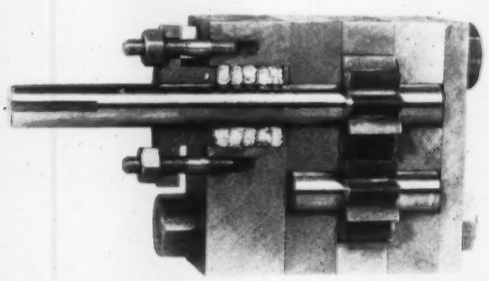


Valves for 4-way control of double acting air cylinders provide instantaneous push button control from one or more stations

Model E is available in two sizes with ¼ or ½-inch I. P. connections, furnished for operation on 110 or 220-volt alternating or direct current circuits. The Hannifin company also has developed an electrically-operated valve, model C, for remote control of air cylinders and a valve unit, model D, designed for time cycle operation or remote control of an air cylinder.

Larger Nitralloy Steel Pumps Developed

USING the same laminated plate construction successfully applied to two smaller series, Northern Pump Co., Minneapolis, has developed a new and larger series of nitralloy steel pumps having capacities from 14 to 42 gallons per minute at 1200 revolutions per minute. The new XE series supplements the XA and XD series and gives a complete line of pumps with capacities from ¼ to 42 gallons per minute.

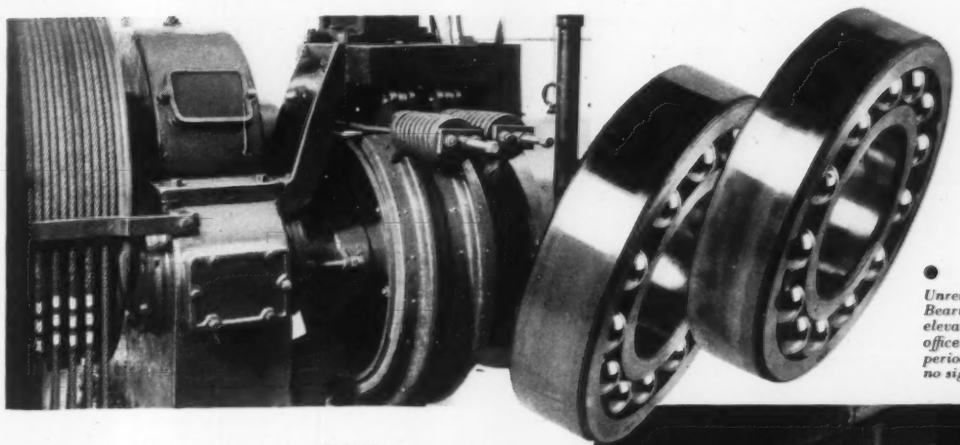


Laminated plate construction is employed in larger series of nitralloy pumps

The extreme hardness of nitralloy steel (1000 brinell) makes these pumps suitable for all types of oil services, including the handling of dirty crude oils and distillates at high pressures. For

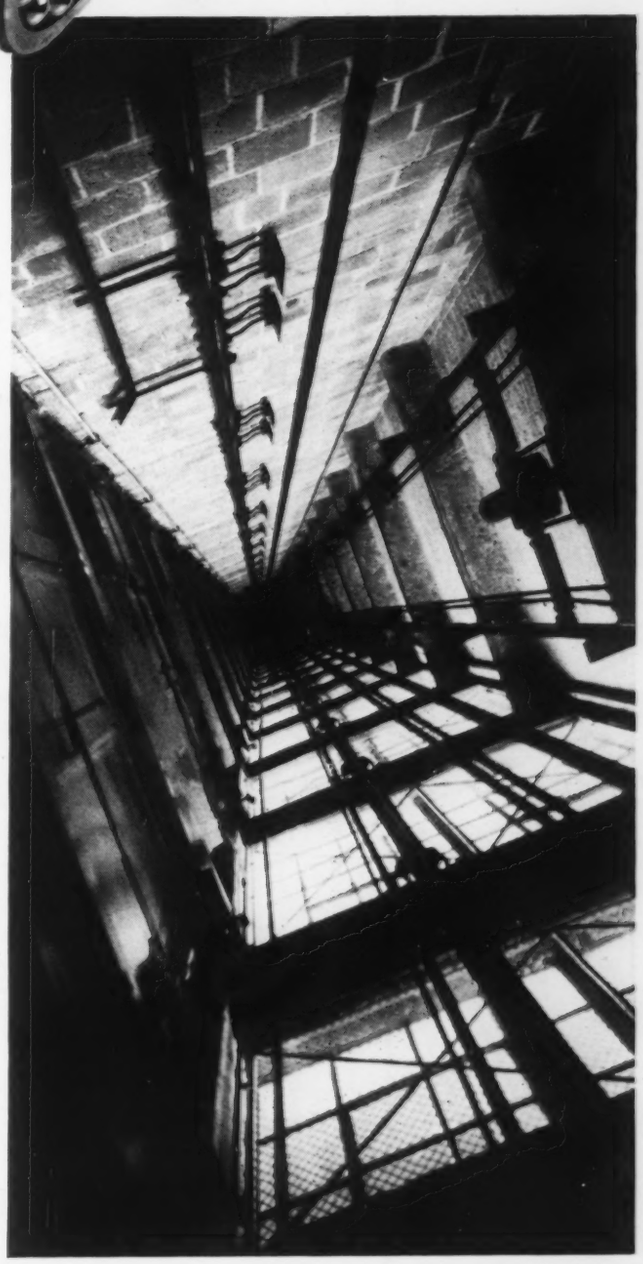
Two SEVENTEEN YEAR OLD BEARINGS

... NOT BOUGHT ON A BASIS OF PRICE!



Unretouched photograph of two SKF Bearings that served for 17 years in the elevator machinery of a Cincinnati office building. In spite of their long period of service, they show practically no signs of wear.

Elevator machinery unit in which two SKF Bearings were used for 17 years. Bearings are still in serviceable condition.



Bearings such as SKF, cannot be judged on a basis of price . . . years are the things that count . . . years of uninterrupted, trouble-free performance.

How, for example, could price alone determine the value of the two SKF Bearings illustrated here? Back in 1915 they were installed in a hard-working building elevator in Cincinnati. In 1932, seventeen years later, they were removed during a period of general overhaul. And there's hardly a sign of wear to tell the tale!

Thus, once more is justified the SKF practice of employing special steels . . . of manufacturing to high standards of precision . . . of producing all bearings *up* to a definite standard of performance and not *down* to a low selling price.

It is well to remember when it comes to a matter of bearing selection that "It costs more to replace a cheap bearing than to buy the best that SKF ever produced."

SKF INDUSTRIES, INC., 40 EAST 34th ST., NEW YORK, N.Y.

SKF

BALL & ROLLER BEARINGS

2845

A PROMISE IS ONLY A PROMISE

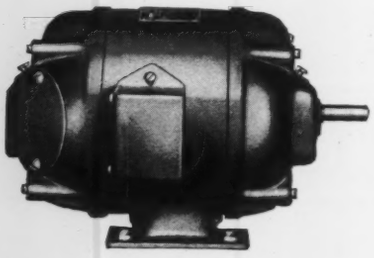
... PERFORMANCE IS HISTORY

nonlubricating oils the pumps are equipped with nitralloy plate bearings such as shown in the accompanying illustration. Roller bearing pumps handling clean lubricating oil are good for pressures up to 1600 pounds on continuous service.

The pumps with roller bearings are suited for installations on hydraulic hoists, lifts, cranes, conveyors, bulldozers, hydraulic snow plows, presses, dump trucks, stokers, machine tools, road machinery and similar equipment. The same pumps built with nitralloy bearing plates can be applied to fuel oil burners in industrial plants and for all types of transfer service where nonoxidizing liquids are to be handled.

Designs New Single Phase Motors

BRUSH riding single phase induction motors of the repulsion start type intended primarily for those applications where the most quiet operation or the higher operating characteristics are not required are a recent development



New line of motors is intended for applications where the most quiet operation is not required

of Century Electric Co., St. Louis. This line of motors is intended to replace the line of brush lifting motors manufactured by the company which will continue to be supplied for long hour per year applications such as refrigerators, oil burners, etc.

Safety Is Designed Into Push Button

MANUFACTURED with the start button inside of the stop button the new push button switch developed by Lincoln Electric Co., Cleveland, includes a safety factor and a number of other improvements not available in previous designs. The stop button can be operated from any angle by merely striking the front of the control box with the flat of the hand, but the start button must be operated with the finger. With the new push button, shown herewith, the stop button can be locked in the off position by pushing it in and twisting it to the right. Heavy springs prevent accidental operation of either button when not locked.

The button is said to handle the heaviest control circuits up to 600 volts alternating or direct current because the contact opening is larger than usual. The contacts use extra heavy double break solid copper contacts which have a positive wiping action. Contacts are enclosed in a dustproof, cold-molded asbestos case.

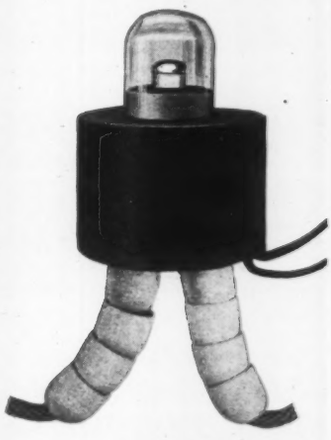
The button is self contained and need not be

Start button is inside of the stop button on this switch, thus affording elimination of accidental operation

taken apart or even removed from the box cover for wiring. All of the terminals are marked clearly and brought out of the case to the back where they are easily accessible. The new safety switch is known as type A-31.

Switches Employ Special Contacts

IMPROVED mercury switches in a full line ranging in capacity from 1 to 100 amperes have been announced by Providence Electric Controls Inc., 763 Allens avenue, Providence,



Magnetrole mercury switch operates entirely by magnetic control. Arc takes place around the edge of a treated ceramic tube which will withstand high temperatures

R. I. In types having a rating up to 5 amperes special heat resisting contacts are used. In the larger switches arcing takes place over a ceramic surface eliminating the danger of tube breakage.

A new feature is the Magnetrole mercury

G-E WELDING

AN INVALUABLE AID TO DESIGNERS

EXAMPLE NO. 2

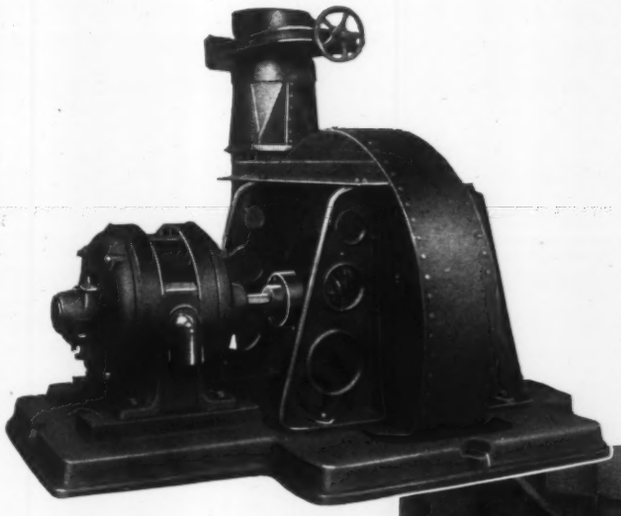
The American Blower Corporation

G-E WELDING means the fabrication of machinery from standard steel shapes and plates, utilizing General Electric's complete arc-welding service.

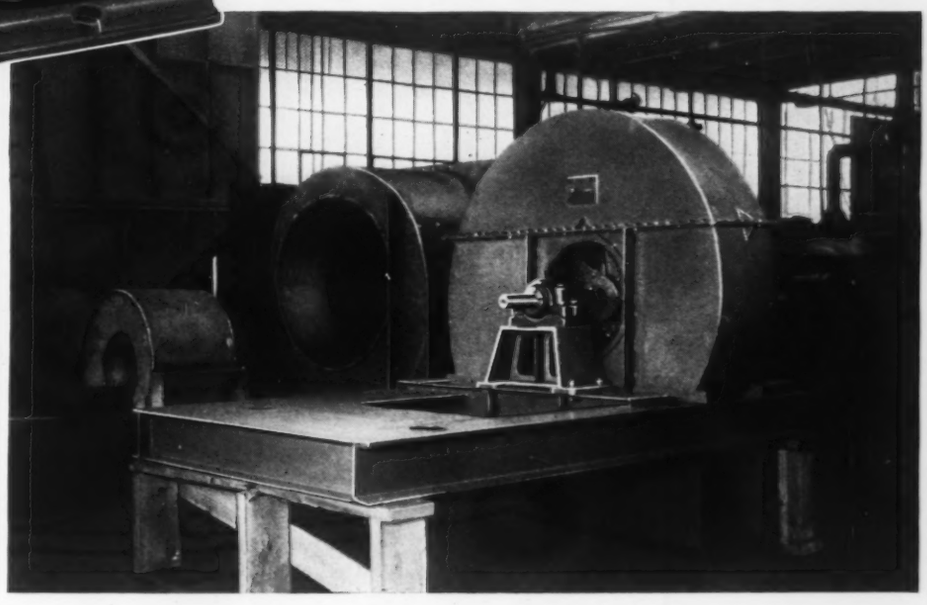
The adoption of G-E welding by the designers of The American Blower Corporation has resulted in a far simpler design, reduction in weight, saving in materials, more pleasing lines, and fewer machining operations.

No longer does each sub-base for the heavy fans require a separate pattern; one solid welded joint replaces a number of riveted or bolted joints where the side sheets join the scroll; gone are the careful fitting operations and gaskets formerly used to make the fan housing leak-proof.

Investigate G-E welding. It embraces application-engineering advice, expert training for your operators in the G-E welding school, and a complete line of arc-welding equipment, electrodes, and accessories. Simply call your nearest G-E office.



Before: American Pressure Blower as manufactured before the adoption of arc welding



After: A similar but much larger type of blower after the adoption of G-E WELDING

530-124

GENERAL ELECTRIC

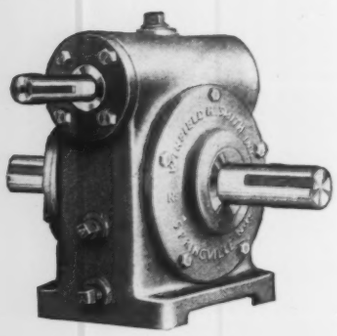
switch, shown herewith, which operates entirely by magnetic control. A gas filled tube containing two mercury pools and a floating displacement member is placed within the field of an electrical coil. When the coil is energized, the floating piece within the tube is drawn down displacing a certain amount of mercury. This causes a rise in the level of one of the mercury pools with a consequent merging of contacts. The arc takes place around the edge of a treated ceramic tube which will withstand extremely high temperatures without deterioration. Patents have been applied for on this type of switch which will be supplied to manufacturers of relays and other current controlling devices.

Adds Line of Rounded Belting

ROUNDED Tannate belting of special construction has recently been added to the line of transmission equipment manufactured by J. E. Rhoads & Sons, 335 North Sixth street, Philadelphia. This special belting is made up of 25 different materials and is said to provide better economy and to lower the power required for transmission purposes. The belting is furnished in sizes from ⅛ to 9/16-inch and in 1000, 500 and 100-foot lots. Smaller orders may be placed.

Rounds Out Line of Speed Reducers

TWO new series of worm gear speed reducers have been developed by Winfield H. Smith Inc., Springville, Erie county, N. Y., to round out the company's line and enable it to offer standard units for practically any requirement from 1/20 to 5 horsepower output capacity. The No. 4½T shown herewith, is a quality speed reducer in the medium duty field with worm located above the gear. The worm is cut integral with the high speed shaft which is mounted on thrust



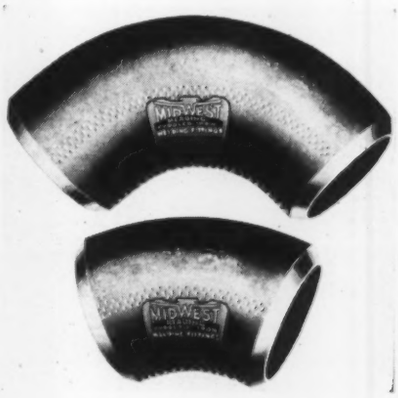
Special oil seals and drilled return passages eliminate all traces of oil leakage from new worm gear speed reducers

ball bearings. The worm gear is of phosphor bronze. Special oil seals and drilled return passages eliminate all traces of oil leakage. Standard ratios and horsepower capacities based on 1750 revolutions per minute of high speed shaft are: ratios of from 6:1 to 60:1 and horsepowers of from 1.50 to 0.25.

The No. 3½B, designed for transmitting loads up to ½ horsepower, is compact and efficient. The housing is made with a solid top and large side cover plate, which permits keying the worm gear to the shaft and complete assembly work on the worm gear shaft before it is put into the housing. Worm gear is of phosphor bronze, while the worm is of hardened steel cut integral with the shaft. All shaft extensions are protected by special oil seals. Standard ratios for this unit are 58:1, 36:1, 18:1 and 9:1. Special ratios are available.

Develops Wrought Iron Welding Ells

WELDING ells made from puddled iron are now being marketed by Midwest Piping & Supply Co., 1450 South Second street, St. Louis. These ells, shown herewith, were developed for



Welding ells made of wrought iron have included angles and center-to-face dimensions of great accuracy

the many jobs where genuine wrought iron pipe is advantageous, their resistance to corrosion, welding characteristics, uniformity and dimensional accuracy being important features. At present, the sizes manufactured are from 2 to 10-inch inclusive, with both standard weight and extra heavy available.

The included angle of every ell is 90 or 45 degrees and center-to-face dimensions are maintained accurately. Long tangents are another distinctive advantage. One quarter inch of tangent is provided for each inch of fitting diameter; thus an 8-inch ell has tangents 2 inches long.

Each ell is made from one piece of puddled iron skelp by a special process developed and patented by the manufacturer. There is one welded longitudinal seam along the inner circumference. The Midwest line of welding fittings, including heads, sleeves and saddles in addition to ells, made from mild steel pipe material, was described on page 72 of the November issue of MACHINE DESIGN.

START with the DRIVE

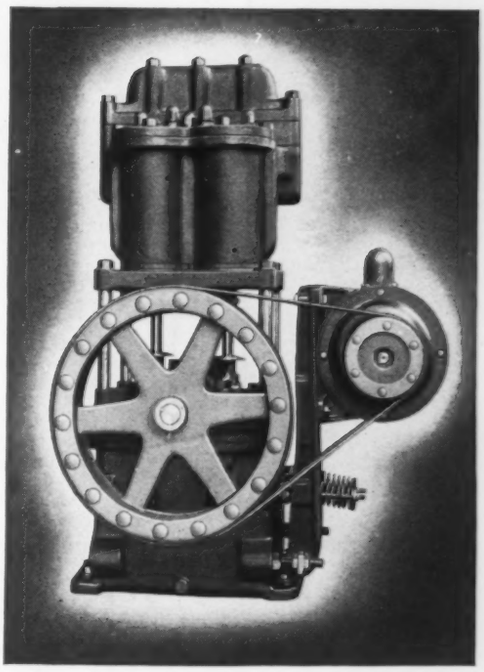
—TO IMPROVE YOUR MACHINES

● The type of drive you furnish between motor and driven machine governs *to a great extent* the machine's performance.

By applying the Rockwood Short-Center Drive to your machine, you will be able to increase capacity greatly, reduce power consumption as much as 10%, and get other important operating advantages. These facts can be verified by simple tests in your own shop.

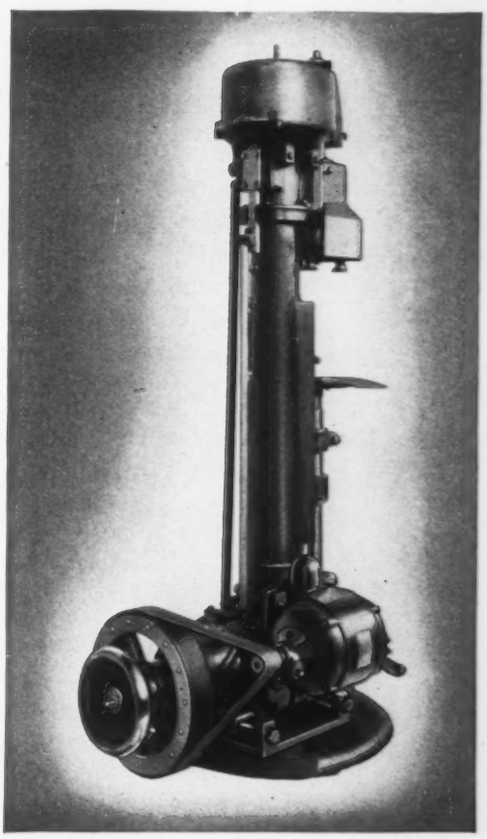
By its automatic control of belt tension, the Rockwood Drive whips the "meanest" load conditions. Power is *delivered*—not *absorbed*. This simple, quiet, clean drive assures years of trouble-free service with *undiminishing* efficiency.

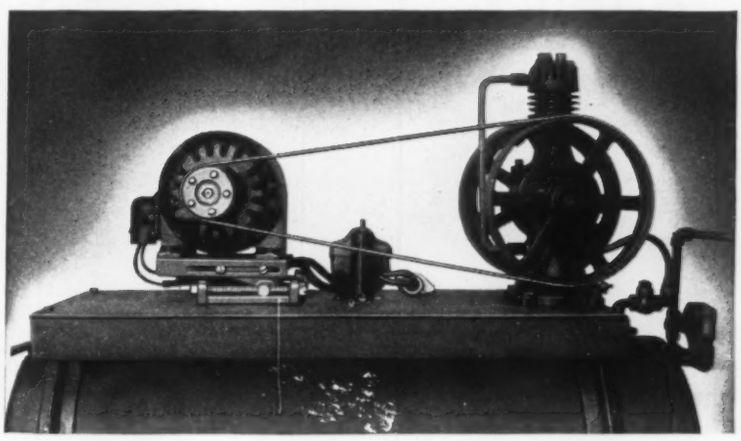
Rockwood engineers have aided other machine designers in improving their machines by improving their drives. May we help *you?*



Above—Rockwood *Drive, special mounting, provided as standard equipment on Dean Bros. Oil-Bath Pumps. Used since 1928.*

Below—Rockwood *Drive, special mounting, designed for Bottle Capping Machine, replacing toothed gears. ¼-H.P. motor. Pulley ratio, 7:1.*





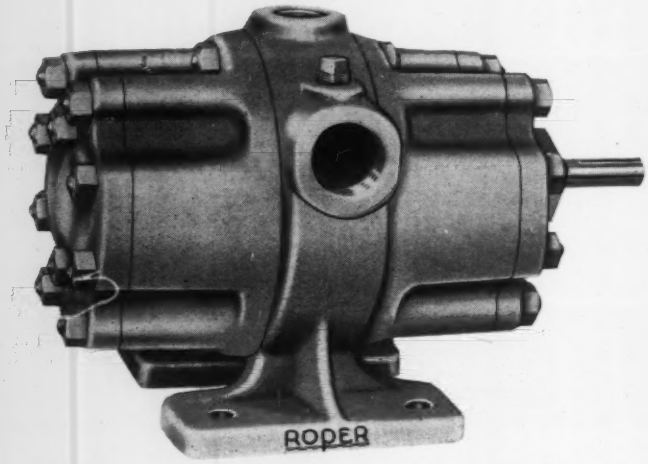
Air Compressor with standard Rockwood *Drive base, fractional horsepower design.*

Rockwood Short-Center Drive bases are available in stock sizes for all motors up to 100 H.P. They are adaptable to many machines for standard drive equipment. If a stock-size base is not suitable for your machine, we will be glad to design and furnish a special mounting to meet your specific requirements.

THE ROCKWOOD MANUFACTURING CO., INDIANAPOLIS, IND.
THE OHIO VALLEY PULLEY WORKS, INC., MAYSVILLE, KY.
Divisions of General Fibre Products, Inc.

ROCKWOOD DRIVE
SHORT-CENTER FLAT BELT

A new specially designed sleeve bearing Pressure Pump



for non-lubricating liquids

A herringbone gear, sleeve bearing, pressure pump. Especially adapted to uses in the Rubber, Soap, and Chemical Industries; also on large hydraulically actuated elevators; and other installations where the use of petroleum products as the hydraulic medium is undesirable.

ROPER

Roper manufactures a COMPLETE line of hydraulic pressure pumps for pumping lubricating or non-lubricating liquids. Efficient and economical operation is assured. Pumps built in a wide variety of sizes, capacities, and with great mounting flexibility. Readily adapted to any hydraulic installation requiring not over 1000 lbs. pressure.

Fill out and mail the coupon below for additional information.

Name .....

Company .....

Address .....

I am interested in pumps for: .....

GEO. D. ROPER CORP.

480 Blackhawk Ave., Rockford, Ill.

Noteworthy Patents

(*Concluded from Page* 64)

ring 14. If the ring is held against rotation as the piston reciprocates, the pawls 16 will ride the teeth 15 when the piston moves in one direction and engage behind them when it moves the opposite way, thereby rotating the piston step-by-step.

The invention incorporates means for frictionally holding the ratchet ring 14 against rotation, overlapping wedges 17 and 18 being provided. The inner wedges 17 have their inner faces curved to conform to the periphery of the ratchet ring 14 and frictionally bear against it. Outer wedges 18 are interposed between wedges 17 and the wall of chamber 13. Wedges 18 have their larger edges abutted against stop pins 19, while the larger ends of clutch wedges 17 are engaged

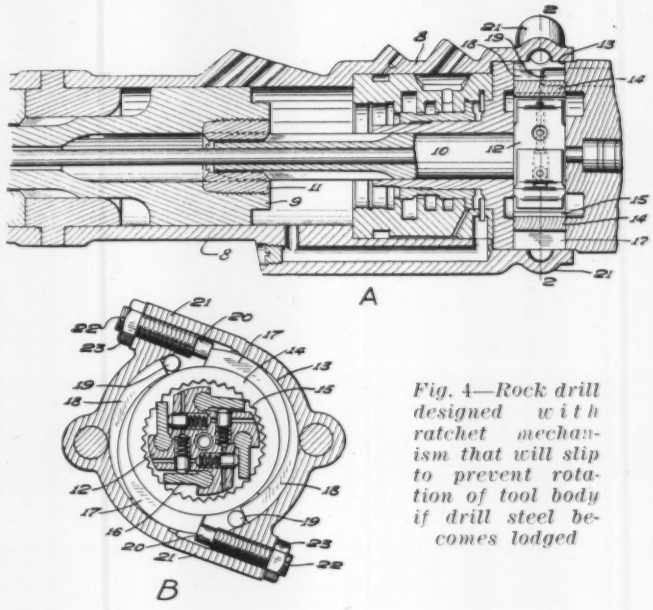


Fig. 4—Rock drill designed with ratchet mechanism that will slip to prevent rotation of tool body if drill steel becomes lodged

by the adjusting bolts 20. If the wedges 17 are adjusted properly they will bear with sufficient force against the periphery of ratchet ring to prevent its rotation under normal drilling conditions. If, however, the drill steel becomes lodged so that it cannot turn readily, the ring will slip. The resistance to slipping movement can be varied by adjusting bolts 20.

Upholding the family tradition established by his illustrious father, Theodore M. Edison, youngest son of the late Thomas A. Edison, recently obtained his first independent patent. It covers a device for eliminating vibration in machinery and has been designated No. 1,855,570 by the United States patent office. A complete description will be presented in this department in the June issue of MACHINE DESIGN.

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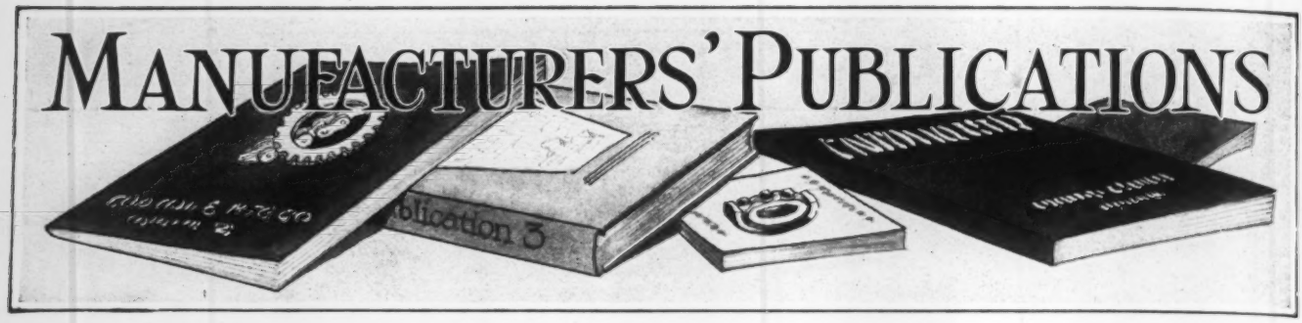

Publications listed in this section may be obtained by engineers responsible for design from the manufacturers of the products or through MACHINE DESIGN

ALLOYS (IRON)—Heat and corrosion resisting alloys of nickel and chromium are covered in bulletin 100 of Electro Alloys Co., Elyria, O. Thermalloy alloys A, B, C, and D, high nickel chromium, medium nickel chromium, chromium iron and rustless iron are described and engineering information is given. These alloys are to be used for castings.

ALLOYS (MAGNESIUM)—Dow Chemical Co., Midland, Mich., has prepared a booklet describing the commercial magnesium-base alloys which they have developed and now are manufacturing. The booklet includes chemical compositions, physical constants and mechanical properties of the alloys as used in sand castings, die castings, extruded bars and shapes, forgings, and sheets.

BEARINGS—Hyatt Roller Bearing Co., Newark, N. J., has issued an extremely well prepared booklet on the fortieth anniversary of founding of the company which presents the bearings manufactured and describes the manufacturing control under which they are made. The booklet is illustrated throughout with photographs of the bearings and of the machinery used in their manufacture.

BEARINGS—Information on the exclusive types of ball bearings manufactured by Auburn Ball Bearing Co., Rochester, N. Y., is included in the new 36-page ball bearing data book issued by the company. Descriptions of bearings, mounting instructions, dimension lists, lists of stock sizes and capacity tables are arranged for quick reference. Special types of bearings which can be furnished, and helpful suggestions on bearing installations are included.

CAST PARTS—Heat and acid resisting castings manufactured by Standard Alloy Co., Cleveland, are described in bulletin No. 21 just issued by the company. The wide range of alloys manufactured is described, with practical applications, analyses, and safe working fiber stresses given, and there is included accompanying data to guide designers to the proper alloy to use.

CLUTCHES—One revolution clutches manufactured by Conway Clutch Co., Cincinnati, are covered in a new bulletin, K-32, recenty issued by the company. The bulletin gives information on types with an extended sleeve, cam knockout types, models for use where the shaft is always running, and mechanism for manufacturers who wish to furnish their own drive members.

CONTROLS (ELECTRICAL)—Cutler Hammer Inc., Milwaukee, has issued new catalog inserts on auto transformer manual motor starters, multi-speed drum switches, two and three pole enclosed automatic motor starters, explosion proof automatic motor starters, three position pilot switches, single pole limit switches, and electronic timing devices for welder and other industrial service.

CONTROLS (ELECTRICAL)—General Electric Co., Schenectady, N. Y., has prepared a number of catalog inserts on magnetic switches. These additions are GEA-19G on CR7006-D7B and D7F magnetic switches for alternating current motors, which give thermal overload protection, GEA-1565 on CR7009 magnetic reversing switches for alternating current motors, which also have thermal overload protection; GEA-1587 on CR7008 combination magnetic switches, an across-the-line starter for induction motors; and GEA-1588 on explosion proof CR7006 magnetic switches for class I, Group D hazardous locations.

DRIVES—High speed herringbone reduction gears suitable for drives where silence is a factor are described in bulletin T-111 of Murray Iron Works Co., Burlington, Iowa. The units are especially applicable for generator, pump and blower units having turbine, motor or oil engine drive. Complete information of their construction is given in the bulletin.

DRIVES—Features in the design of variable speed transmissions manufactured by Lewellen Mfg. Co., Columbus, Ind., are presented in a new folder of the company. The folder specifically treats the details in the design of the transmission which set it apart from similar units, and traces the effect of these details on the efficiency of the equipment.

LUBRICATION—Standard Oil Co. (Indiana), Chicago, has released the first of its series of technical monographs on the lubrication of industrial equipment. The monograph issued in April treats comprehensively the subject of reducing cost of lubrication. Following monographs will deal with the lubrication of particular types of equipment.

MOTORS—Type KE single speed induction motors for elevator service are presented in catalog insert GEA-1580 of General Electric Co., Schenectady, N. Y. The motors are furnished in sizes from one to 60 horsepower for service on 208, 220, 440 and 550 volts.

PACKING GLANDS AND PACKING—Oil seals and diagrams showing the application of a simple new type of seal on various classes of machinery where it is necessary to eliminate the leakage of oil, grease, water and other liquids along shafts and to keep dirt, grit and water out of bearings are presented in a 16-page booklet issued by Aetna Ball Bearing Mfg. Co., Chicago, entitled "They Shall Not Pass."

PUMPS—Worthington Pump & Machinery Corp., Harrison, N. J., has issued catalog insert booklet W-321-S1A on type D monobloc centrifugal pumps. These units find application as built-in parts of assembled equipment, air conditioning apparatus, general house service, agricultural drainage and irrigation projects.

WELDED PARTS AND EQUIPMENT—The second edition of an 80-page booklet on electric arc welding has been published by Hobart Bros., Troy, O. The booklet is arranged logically, conveniently indexed for ready reference and contains essential facts covering the successful application of arc welding to many types of work.

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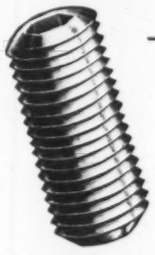

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Change making machines
Check writing machines
Clay working machinery
Clothes pressing machines
Coffee roasting and grinding machines
Condensers
Confectionery and ice cream machinery
Conveying machinery
Cotton gins
Cranes, including hoists and derricks
Dairy machinery
Dish washing machinery
Dredging and excavating machinery
Electrical machinery
Elevators and elevator machinery
Engines, steam and internal combustion
Fare registers and boxes
Flour mill and grain mill machinery
Foundry machinery
Gas machines
Gas regulators
Glass making machinery
Hat-making machinery
Hydraulic machinery
Incandescent lamp making machinery
Laundry machinery
Lawn mowers
Leather working machinery
Locomotives
Machine tools
Manifolding machines
Metal working machinery
Meters, gas and water
Mining machinery
Miscellaneous and special machinery
Motion picture cameras and projectors
Motorcycles and bicycles
Motor vehicles
Oil-mill machinery
Oil-well machinery
Ore crushers
Packaging machines
Packing house machinery
Paint making machinery
Paper box machinery
Paper mill and pulp mill machinery
Pharmaceutical machinery
Photo-engraving machinery
Pneumatic machinery
Printing machinery
Pumps and pumping machinery
Refrigerating and ice making machinery
Road making machinery
Rolling mill machinery
Rubber working machinery
Scales and balances
Sewing machines
Shoe machinery
Slicing machines
Slot vending machines
Stokers, mechanical
Stone working machinery
Sugar mill machinery
Textile machinery
Tobacco manufacturing machinery
Transmission machinery
Typewriters
Vacuum cleaners
Washing machines, ironing machines
Welding machines
Well-drilling machinery
Windmills and towers
Woodworking machinery

*Machines as classified by the United States Census Bureau